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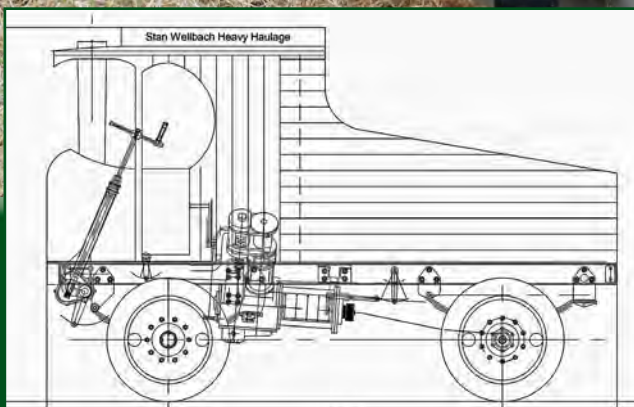
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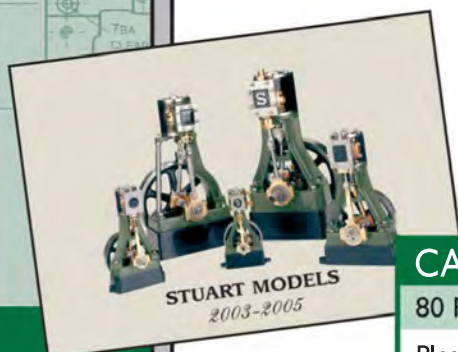


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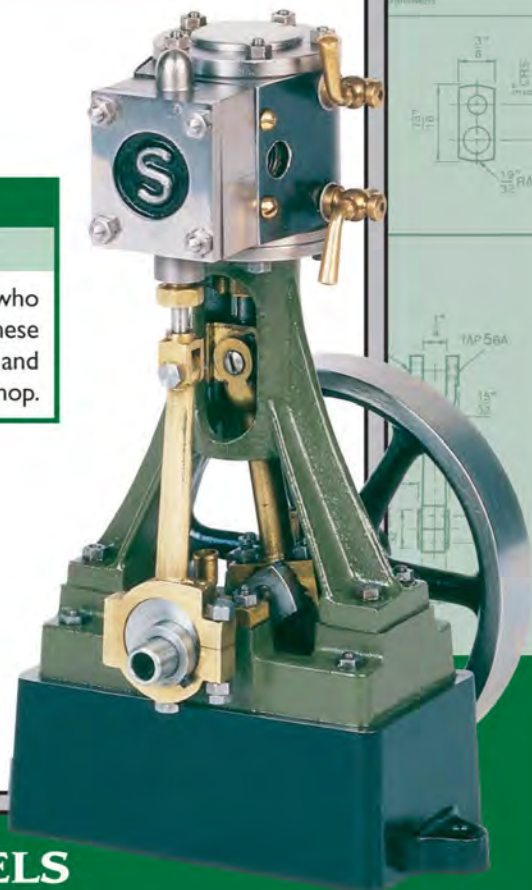
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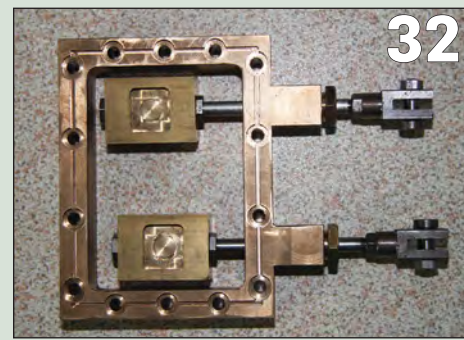
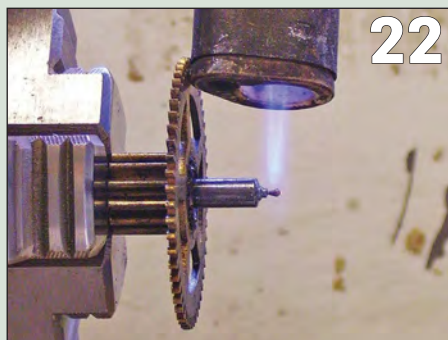
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ENGINEERING
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FRONT COVER

Smiles and waves from the dignitaries as the newly-named 'The Brigadier' takes the first official passenger train around the North Wales Model Engineers' completed new track at Llandudno. More on page 40.

Photo: Andrew Charman

EDITORIAL

Enjoying a day out at a new track...

Welcome to this edition of **EIM**. It's been another busy month, and a definite highlight was on 21st July when accompanied by my good lady I headed directly north from **EIM** Towers to the seaside town of Llandudno, and the official opening of the new and impressively long track of the North Wales Model Engineering Society.

We live in times of challenge for all clubs in our hobby – attracting new members is a



constant concern, as is the cost of maintaining tracks on land that is often eyed greedily by property developers. So what made the visit to Llandudno particularly enjoyable was to hear how closely the North Wales club, which lost its previous site seven years ago, has been able to work with both the county and town authorities to establish the new site. In fact both the Conwy County and Llandudno Town councils regard the new track as an attraction, an asset to the local

area. With support such as that it can only prove a success... I'm delighted to be able to tell you that Martin Gearing met up with me at the Welshpool & Llanfair Light Railway recently (having a steam railway just down the road is a very handy location in which to conduct the business of a model engineering magazine...) and delivered the entire series describing the boiler that he has constructed to power his Steam Plant serialised in **EIM** last year. So if you have built a Steam Plant, ready your workshop, as we will start describing the boiler in next month's issue.

Meanwhile you will hopefully find plenty of interest in these pages this month, from a fascinating large-scale steam lorry project, through some long-overdue horology, to one of Jan-Eric Nyström's typically engineering-centric solutions to stabling his rolling stock. Enjoy the issue, and if you've built something to interest your fellow model engineers, then send some words and pictures in!

Andrew Charman – Editor

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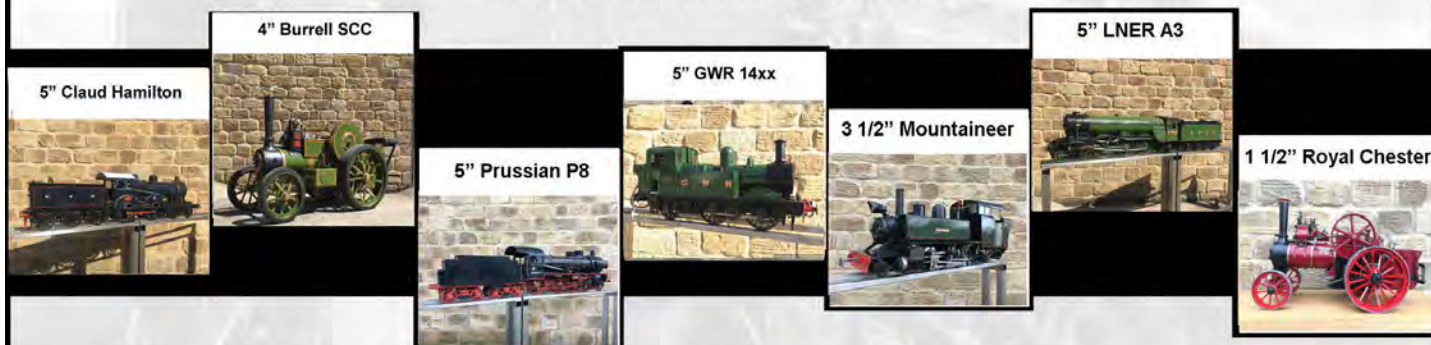
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Building a large-scale Fowler Steam Lorry

Martin is part-way through his major project in the unusual 7-inch scale. This two-part feature reveals his thinking behind the build and his fascinating design conclusions.

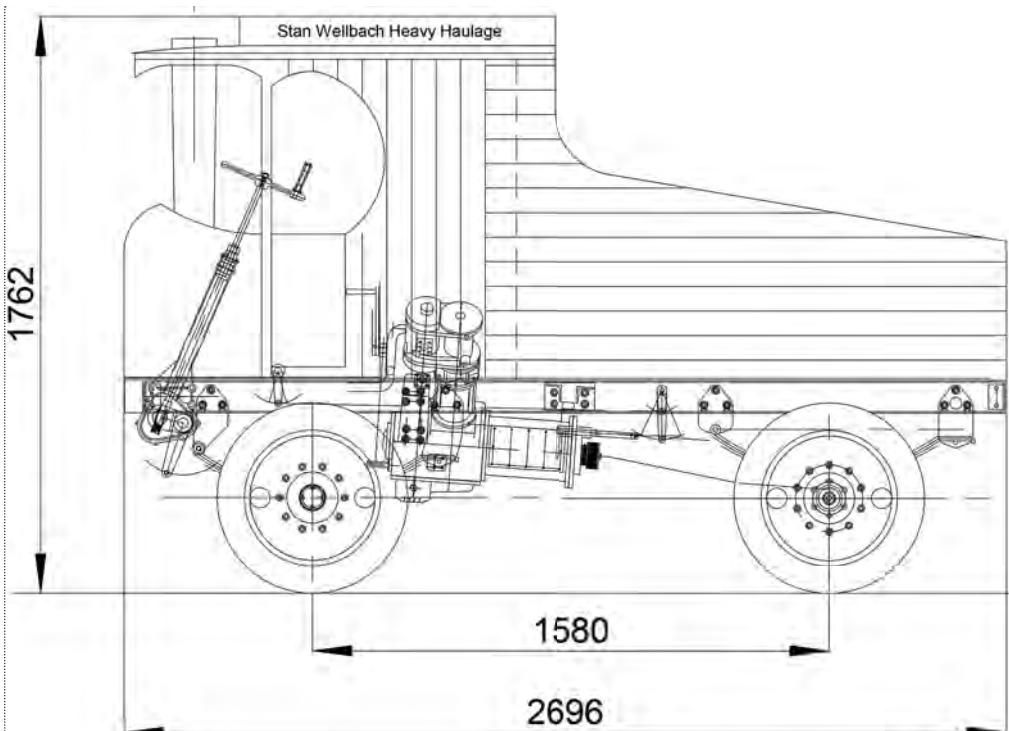
BY MARTIN JOHNSON

The rain came down in sheets as a few die-hard rally visitors huddled in the model and beer tents. Meanwhile, I sat at the controls of 'Charles III', put a few shovels of coal on, and wondered if we would need towing off the site as the rain dripped down my neck in an attempt to meet that soaking upwards from my boots.

Of course, on a sunny day the Burrell and its trailer is a wonderful thing and even short road runs are possible provided the road is quiet. Building the Burrell had occupied me for some 16 years, and I was at that 'in between' stage searching for a new project. I had been thinking about the 6-inch scale Garrett 4CD traction engine as a challenging project, but had not committed.

Through the rain I looked over to the crew of a full-size Sentinel lorry warm, snug and smug in their cab, and it became clear – what I wanted was a steam lorry with a sit-in cab for two people, and with sufficient speed to make road runs feasible and relatively safe.

I had always admired the Foden steam wagon and had considered building the published 4½ or 6-inch scale designs. However, both of these would still have me out in the rain on a day like this and even the larger scale could only accommodate one person at the controls. I had also for many years admired the 9-inch scale Foden wagon design by Mick Cox – a wonderful vehicle seating two in the cab but somewhat beyond my ability



ABOVE: This drawing shows the look of the finished lorry.

BELOW: The Burrell 'Charles III' – fun, but exposed...

BELOW RIGHT: Multiple seats ensure full enjoyment.

to build, transport and afford. I had also seen various other 6" to 9" scale under-type wagon models over the years, some of which were clever designs but too many of which appeared to be manufactured from bitsajunkium. I resolved therefore that my project must have some engineering integrity.

Later in the day, as I winched Charles III onto the road trailer for the journey home, a few other thoughts struck me. The logistics of

rallying a larger model are onerous. There is a lot of 'miscellaneous stuff' needed, such as riding trolleys, tools, lubricants, blowers, coal, extension chimneys, overalls, wet-weather gear and a substantial trailer to worry about. At the time, I was also rallying a 4in scale timber trailer for the Burrell to pull, which made the job even more onerous and my ability to lift and shift that lot might not last forever. If I were to build something on a larger scale, it would need to be



an integrated project that would be self contained and avoid all the loading/unloading problems associated with half a ton of engine, half a ton of road trailer and a quarter ton of miscellaneous. A large model of half to three-quarter scale might be feasible if it was 'self loading and carried the miscellaneous on board.

Back at home, I tried paper engineering exercises on a few existing designs – the Atkinson undertype by Ray Prime, the Clayton by Robin Dyer and the Foden by Terry Morris were all considered for 'enlargement'. All would pose major problems in manufacturing crankcases, crankshafts and back axles on my machine tools. At this point, maybe I should explain that I live in the Scottish Highlands and access to large machinery is a problem; no evening classes and the local club workshop a mere 90 miles away. That being the case, the lorry would have to be built on my 5½-inch Kerry lathe and a Tom Senior M1 mill.

At that stage, I was considering using an A-frame tow for transport, so anything with a chain transmission would probably not survive being towed at up to 70mph, and pneumatic road legal tyres would help as well! Subsequent changes to road vehicle braking legislation means that towing by A-frame is not likely to be feasible, and a bespoke vehicle trailer will be manufactured instead.

Making the decision

I finally looked at a 3-inch scale Fowler steam lorry described by Tony Webster in *Model Engineer* starting in Volume 192, Issue 4213, as a basis for an enlarged model. The Fowler has a V-twin engine, driving through a gearbox via a cardan shaft to a 'conventional' back axle. The boiler unit was a vertical fire tube unit while the chassis and cab were quite conventional for undertype designs of the 1920s.

Choosing this prototype solved quite a few of the manufacturing problems mentioned above:

- The back axle could be adapted from a present-day car axle
- The crankcase was quite small for the size of engine, hence easier to machine. However on the debit side, the Fowler crankcase was a very complex casting and would need re-designing for simplicity
- The crankshaft was also short, bringing it within the scope of my lathe. This shortness would also help in machining the crankcase.

Another very attractive feature of the design for my purpose was that the cab was unusually wide; the Sentinel and Atkinson cabs taper in at the front of the vehicle, which would be very

restrictive for massively over-scale feet.

The design specification for the model was starting to become clear:

- 1) A model based on the Fowler steam lorry in as large a scale as could be manufactured 'in house'
- 2) The vehicle to seat two persons (driver and stoker), preferably inside the cab, but at least under cover
- 3) The vehicle to be capable of a reasonable turn of speed for use on busy roads. It should also be equipped with hazard beacons for high visibility, hence a 12 volt system would be included
- 4) The 12 volt system also to supply an integral low-speed vehicle mover – to avoid the strenuous manhandling of such a large model
- 5) It would have pneumatic tyres and wheels of correct scale appearance for HGV wheels
- 6) Brakes would be provided on all four wheels. Steam vehicles can be near silent and pedestrians seem to develop blindness and suicidal tendencies when among moving steam vehicles
- 7) The boiler would have a Bar-Litre rating just within the 500 limit that could be tested by our club inspectors. Anything larger would require testing by a professional inspector, and a major increase in running costs.

The design phase

The design would be my own, based on Fowler's lorry. Design takes quite a lot of time, but I looked forward to having total control – and not having to blame another designer for the errors in the drawings. I was also keen to explore some of the more theoretical aspects of engine and vehicle design.

The full-size Fowler lorry had a 'reputation' of the wrong sort, and many were part exchanged or scrapped within just a couple of years of new. I would have the opportunity to find and sort out Fowler's design mistakes along the way. The late Curly



ABOVE: The magnificent 9-inch scale Foden built to Mick Cox's design. It was big, but a bit too big for Martin.

BELOW: This wooden half-cab mock up was built on the tailgate of Martin's road trailer to test his theories.

BELOW RIGHT: Inside the half-cab mock up shows how clearance for the cab, steering column and boiler can be an issue.

All photos and illustrations in this feature by M & P Johnson

Lawrence also enjoyed this type of re-engineering exercise. I shall discuss the various aspects of the design work below under separate headings, but in reality they are all connected and were tackled together.

How Big to go?

Initially, I tried to work out a design based on the Fowler in 9-inch scale. I even cut some metal, but it soon became clear that this scale was not going to work for me. The route out of this problem was found by reducing the engine and gearbox unit to 6-inch scale, but revving it somewhat faster than 1920 steam practice would suggest, thus getting the proverbial quart from a pint pot. I felt comfortable that 1000rpm was probably still quite conservative and this had the added bonus of leaving more room in the cab for the over-scale driver and mate.

The next problem was to see how small the chassis and body could be made and yet still accommodate two people. I estimated that something around 5/8ths to 2/3rd scale would do the job. I then constructed a mock-up model of the half cab in 7-inch scale, and adjusted it to suit to ensure clearance particularly for heads and



feet. I also found that a somewhat higher and longer cab than scale would be needed to sit in, but that these changes could be worked in without unduly compromising the appearance of the vehicle.

The 7-inch scale also works very well for tyres. A common space saver tyre size is 125/85 R15; scaled up this works out equivalent to a 40 x 8.4 tyre and the heavy goods vehicle tyre of the day was 40 x 8, which is certainly near enough for me.

Outline Design

There was an outline design phase prior to detailing to ensure that steam demand of the engine and predicted boiler steam production would match. Noted model engineer Jim Ewins addressed this type of problem with his Ee factor; however, his correlations are of 5-inch gauge rail practice which is clearly not directly applicable to larger scale road engines, although the principles certainly are.

It seemed to me that there are two conditions to satisfy:

- Maximum torque – starting the vehicle from standing against the worst conditions, fully loaded uphill, on soft mud, in a rut for a road vehicle. Equivalent to tractive effort in a rail-based application.
- Maximum power – running at speed fully laden uphill. Equivalent to maximum draw bar horsepower in a rail-based application.

In both cases the resistance will be proportional to vehicle weight, so the two ratios tractive effort/vehicle weight, and power/vehicle Weight, will need to be similar to on other steam vehicles.

Fortunately, I had some published test data for a Sentinel wagon (Steaming Magazine, Summer 1987), the full-size Fowler wagon (Fowler Steam Road Vehicles, by W. J. Hughes) and I had also done some simple tests on my 4-inch scale Burrell which gave me some benchmark values. To estimate horsepower generation, I analysed some results in *A Traction Engine Miscellany* by R H Clark to derive an indicated efficiency, which worked out at 50 per cent based on the available enthalpy drop across an engine.

The ability of a boiler to provide sufficient steam must also be considered, so I calculated the grate loading required to produce the steam assuming (rather conservatively) that 1lb of coal produces 6lb of steam. The results came out as in **Table 1**.

Estimating weights at design stage is always a tedious and approximate job, so there is uncertainty there and using a 50 per cent indicated engine efficiency without taking account of superheat is also a gross

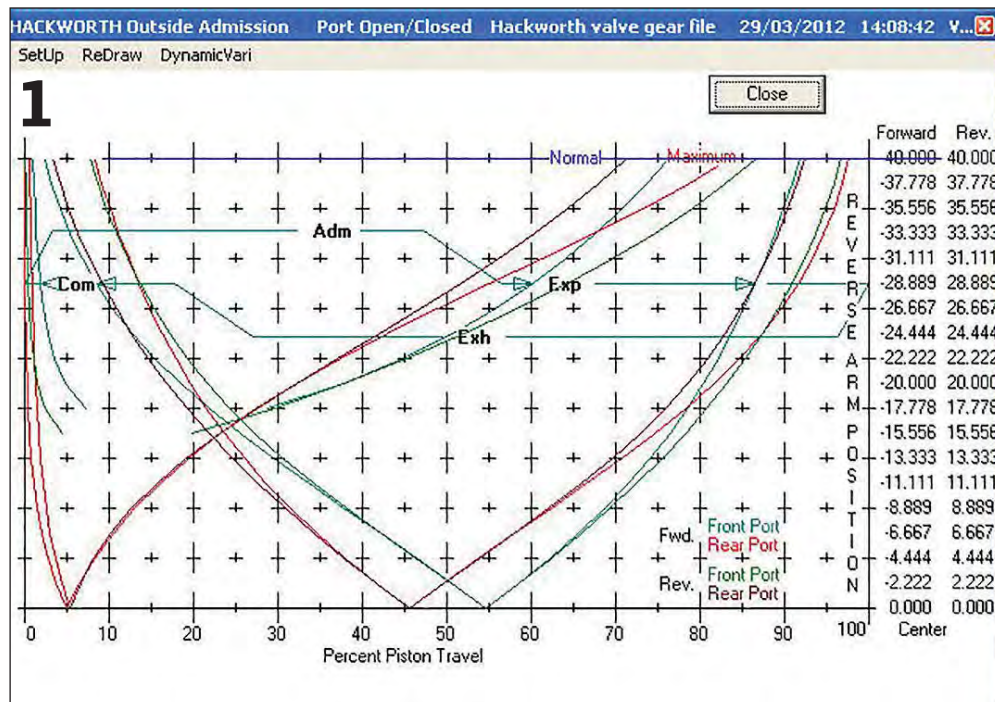


TABLE 1

	4" Burrell + Trailer	Fowler Full Size	Sentinel Full Size	Fowler 7" Scale
Estimated Weight lbs	1707	37649	52885	3659
Tractive effort in Low gear lbs.	590	5631	5620	594
TE / Weight	0.346	0.150	0.106	0.162
Estimated HP	1.82	30.61	34.47	6.63
HP / Ton	2.39	1.82	1.46	4.06
Firing Rate lb/sq.ft/hr	21	24	32	31

FIGURE 1 & 2:

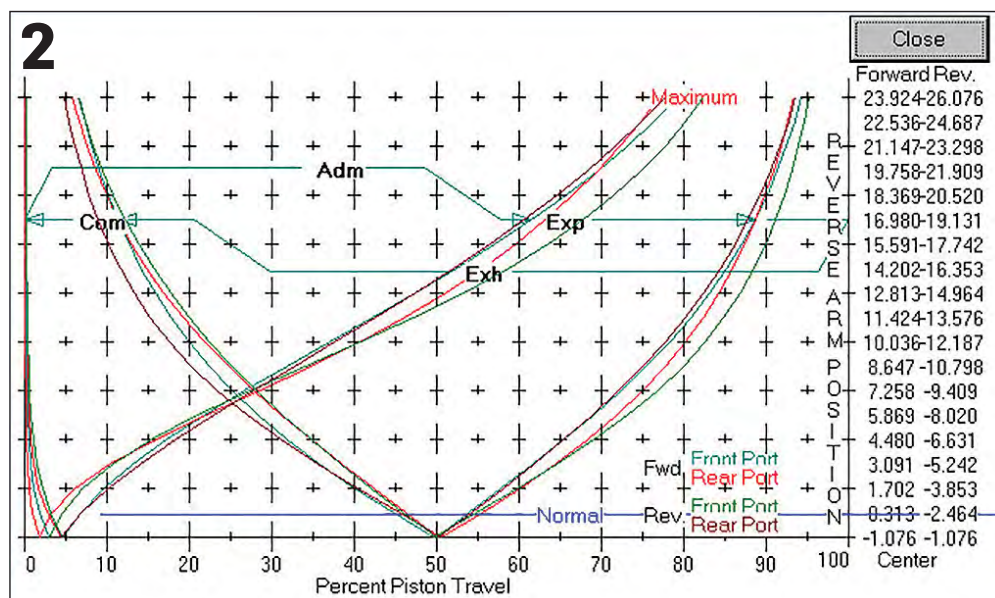
Screen shot of analysis for Hackworth valve gear (Figure 1) and Woolf gear (Figure 2). Full details are given in the text.

approximation. In addition, a 6:1 ratio of evaporation to coal is usually conservative, but it rather depends on the boiler design. However, the table shows that the proposed miniature should have plenty of starting effort compared to its weight and the power per ton is generous.

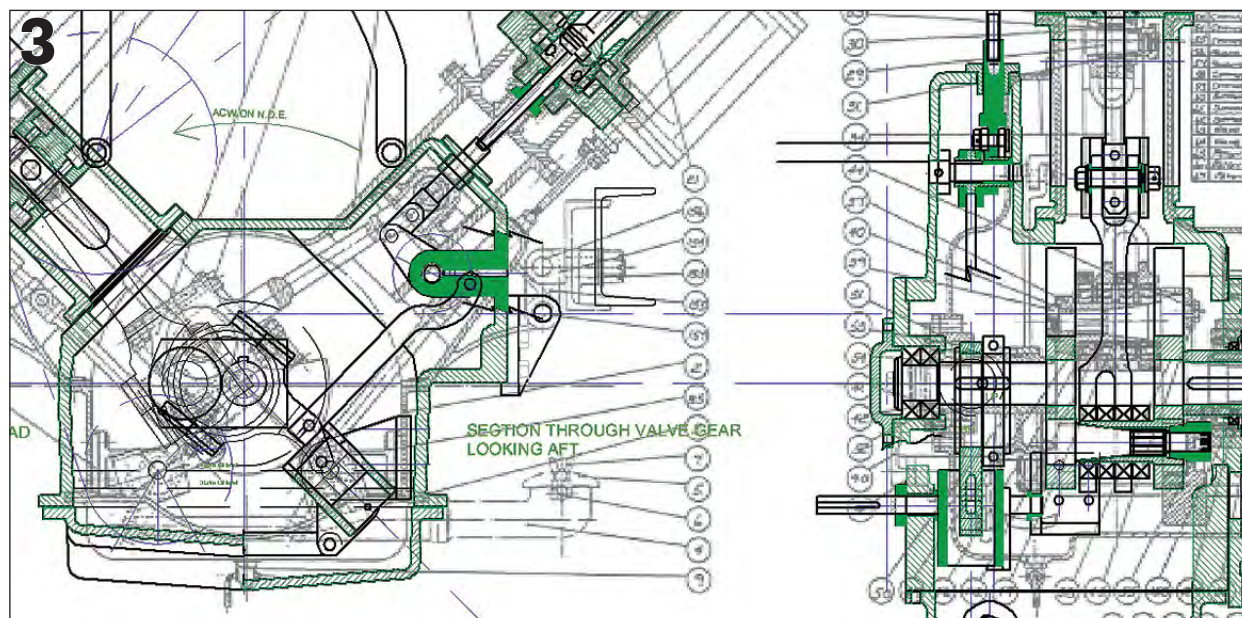
The grate loadings are all modest compared to my analysis of IMLEC results which shows typical grate loadings of 40lb/hour for 5-inch gauge locomotives. In short, the overall

design looks feasible, but there was a lot more detail design and analysis to be done.

As part of the above exercise it became apparent that duplex cylinders in the model would make better use of the available boiler power, which is discussed in more detail below. I notice that most of the model Foden steam wagons have duplex cylinders (the full-size ones were compound) but they run very well from a scale-size boiler.



"The ability of a boiler to provide sufficient steam must also be considered, - I calculated the grate loading required assuming that 1lb of coal produces 6lb of steam..."



Engine Valve Gear

I soon found major problems with the Fowler incarnation of Hackworth valve gear. The Fowler engine is of 'V' configuration with short connecting rods and each cylinder is a mirror image of the other; this means that one cylinder is going forward while the other is in reverse. Therefore, the valve gear has to give good events in both forward and reverse. Hackworth valve gear can be made to give reasonable results with relatively long connecting rods (as in the Sweet Pea locomotive), but with the short rods in the Fowler engine the problems become acute. Analysis of the design using Dockstader's program gave the rather disappointing results shown in **Figure 1**. It will be seen that there are large deviations between the forward and rear conditions.

I substituted Woolf valve gear for the Hackworth - they are both radial gears, the Woolf having an extra linkage to reverse the travel and hence cancel out some of the inherent errors. I have to acknowledge significant help from Simon Bowditch and Don Ashton in this department, but after some development the results were as shown in **Figure 2** which shows much better grouping of the curves, indicating a more consistent performance for both ends of the cylinder in both forward and reverse gears.

Using the Woolf valve gear meant another linkage to design and make, but solved an awkward problem of aligning the cylinder blocks at a strange angle as done on the Fowler.

Boiler & Superheaters

The original boiler was a vertical firetube unit of 3.8 sq. ft. grate, and 85 sq. ft. heating surface supplied via a vertical stoke chute. The smokebox was water/steam jacketed and the

tubes were fully submerged. An extra large diameter steam space helped to ensure dry steam. A superheater coil of 12 sq. ft. was fitted in the smokebox space. Blow off pressure was 225 psi.

The evaporative capacity of the boiler should be similar to the Sentinel product - the grate area of the Sentinel and Fowler boilers are identical. I have calculated evaporative capacity for the larger surface area of the fire-tube Fowler and the smaller

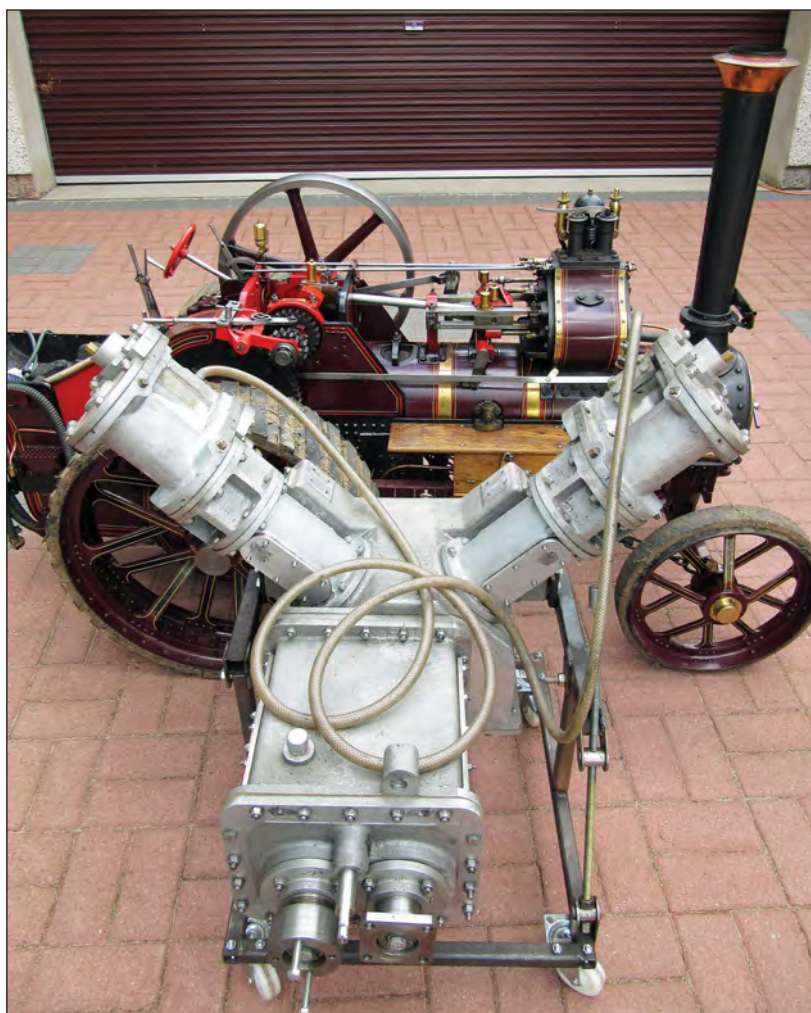
area of the Sentinel water tube and they come out approximately the same. Cylinder sizes for the Sentinel are similar to the high pressure ones of the Fowler, but of course there is only one high-pressure cylinder taking steam on the Fowler compared to the two cylinders of the Sentinel. This indicates the Fowler boiler output was underused, by a factor of around two, thus confirming my decision to make the Fowler miniature

FIGURE 3:

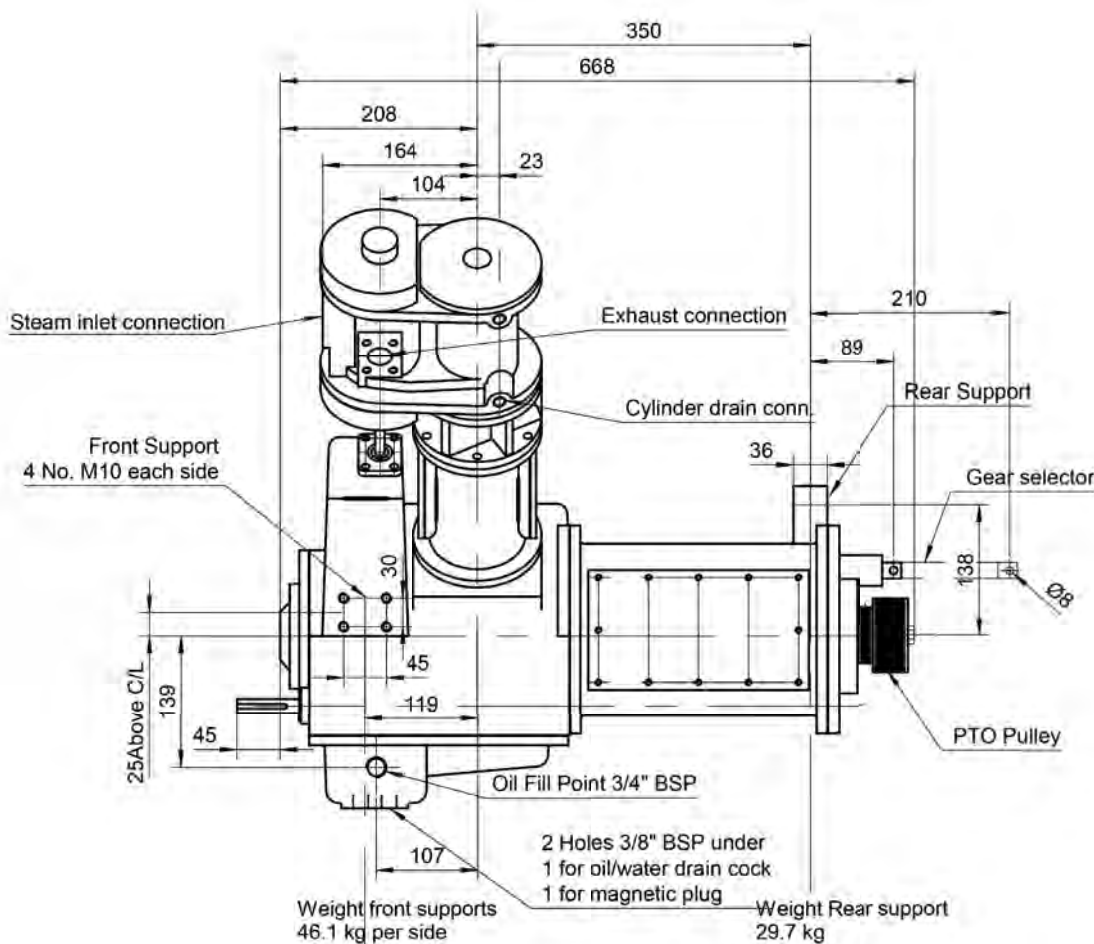
Screen shot of the miniature design overlaid on an original works drawing in TurboCad.

RIGHT:

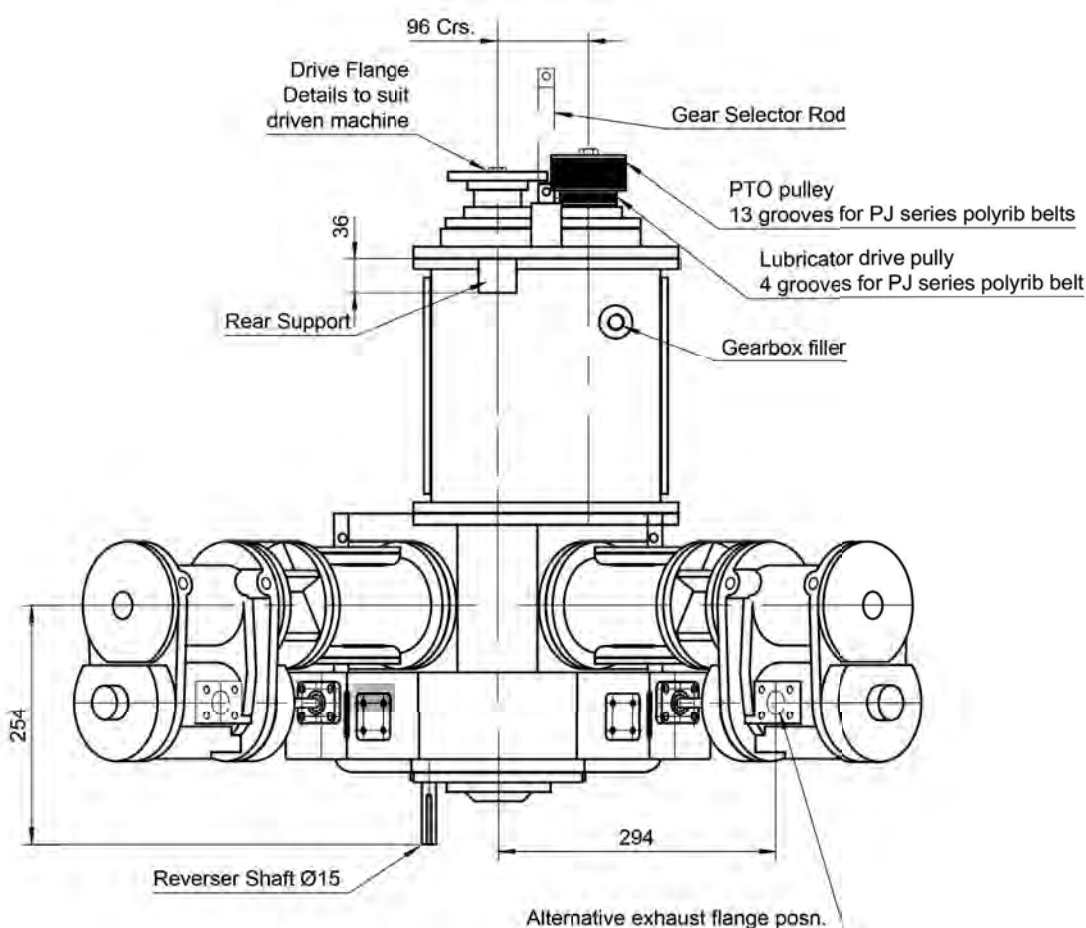
The size of the lorry's engine can be gauged by this picture of it posed against Martin's Burrell. Details of the construction will be in next month's **EIM**.



GENERAL ARRANGEMENT - SIDE VIEW



GENERAL ARRANGEMENT - PLAN VIEW



a duplex or double-high design.

The Sentinel S series had some 24 square feet of superheater, so would have had a much higher superheat than the Fowler, and this seems to be key to a successful design in any scale. Fowler claimed its engine could develop 55 bhp, but the Sentinel developed 130 bhp at peak from an identical grate area!

Following on from the above observations I have undertaken more than two years of work on the thermal design of miniature boilers. This has resulted in a computer program which will predict performance (quantity and temperature of steam) from the geometry of the boiler; an article describing this work is ready for publication. I plan to undertake further work to predict engine performance, picking up where Professor Bill Hall left off and have made a start on this, but the work is nowhere near finished.

Detail Design

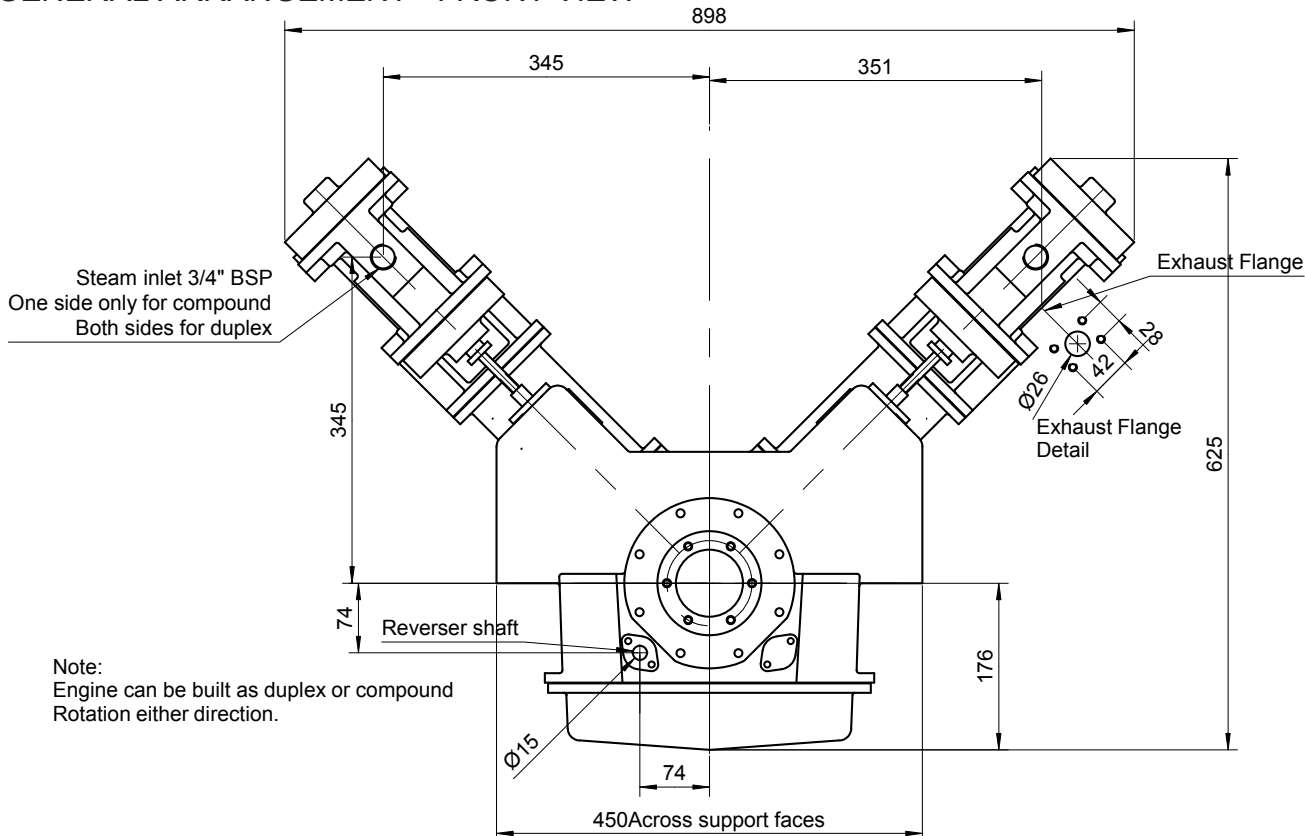
Bolstered by the knowledge that a 7-inch scale model seemed to have significant advantages and could probably be machined in house, really serious detail design work started in July 2010.

I design in 2D and use TurboCad for design and have found a useful method of working that may be of interest to others. It is possible to scan a drawing of a prototype (in my case cross sections of the engine and gearbox unit) which can then be placed on a layer of the CAD drawing. The scanned image is then adjusted for size until key dimensions of the scan match the proposed scaled dimensions. Design work then proceed on other layers which can be viewed with or without the prototype drawings.

The advantage is that the design can proceed using readily available sizes of material, fasteners, bearings, seals and the like, but all the while keeping a reference of how this compares to the scaled prototype. **Figure 3** shows part of the engine cross-section with the layer containing Fowler's engine cross-section visible showing how the model design follows the original, but not precisely.

My own practice is to then copy relevant parts of the design over to detail drawings where the design is refined and fully dimensioned. Once that has been done, all the component parts are copied back to the assembly drawing or cross-section and 're-assembled' to build up the final cross-section drawing. This is an excellent way of discovering foul-ups before they reach the phase of 'Scrap due to D.O. Error'.

GENERAL ARRANGEMENT - FRONT VIEW



Throughout the design I have tried to reflect real drawing office practice in that each component or assembly has its own drawing and all components are listed on a parts list, which is essential for keeping track of materials to be ordered.

Pattern making commenced as soon as enough parts of the design were crystallised and engine patterns were despatched to the foundry in March 2012.

The engine design

Since the engine unit might be of interest to others for cars, lorries or

“This is an excellent way of discovering foul-ups before they reach the phase of ‘Scrap due to D.O. Error’...”

steam boats perhaps, I include here cross-sections and dimensioned general arrangements.

The engine as built is a double-acting duplex unit of 70mm bore and 100mm stroke. I have also made patterns for a compound version which would have a high pressure of 60mm bore and a low pressure of 90mm bore, both on the common 100mm stroke. All components for the compound cylinder version are identical except the cylinder block, end covers and piston.

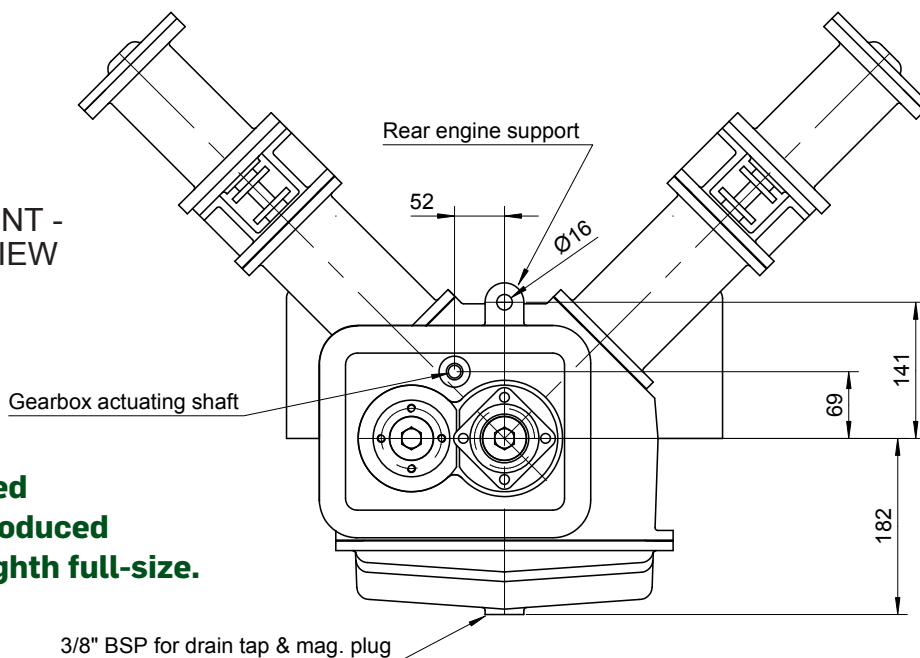
The engine is designed for up to 1000rpm on steam at 160psi although

the calculations indicate it could be pushed further if required. Castings are 'double handed' so can be machined for the high-pressure cylinder to be on either side; the exhaust can also be directed outwards or into the centre of the 'Vee' on the duplex model.

The total engine weight is 125kg, due mainly to the extensive use of aluminium components and rigorous attention to weight reduction. Bearings are ball or roller type with the exception of the valve gear and little ends.

For steam boat applications, I

GENERAL ARRANGEMENT - DRIVE END VIEW

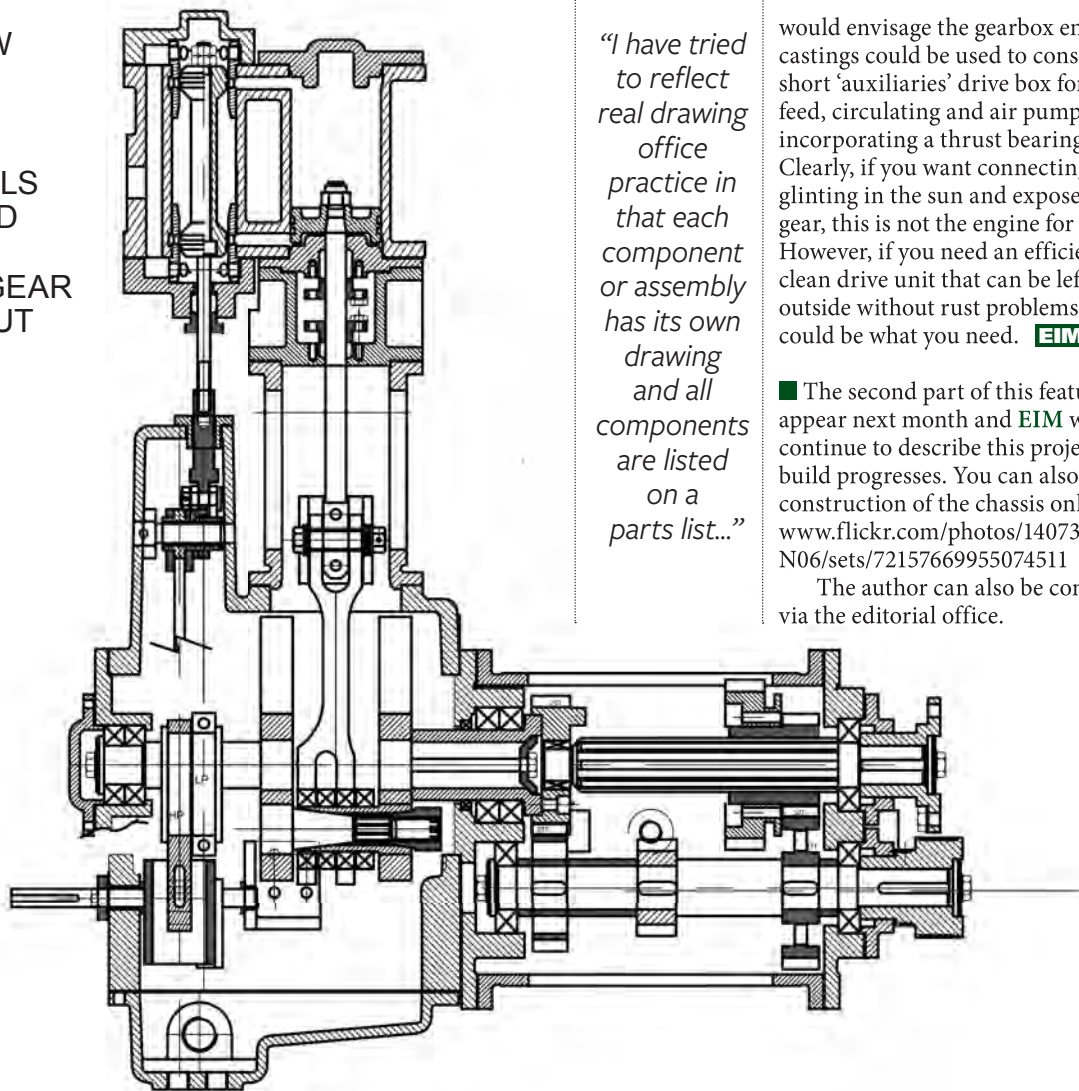


**All dimensioned
drawings reproduced
approx one-eighth full-size.**

SECTIONAL VIEW
THROUGH ONE
CYLINDER

GEARBOX DETAILS
SHOWN ROTATED

SUMP & VALVE GEAR
ALSO SHOWN OUT
OF PLANE



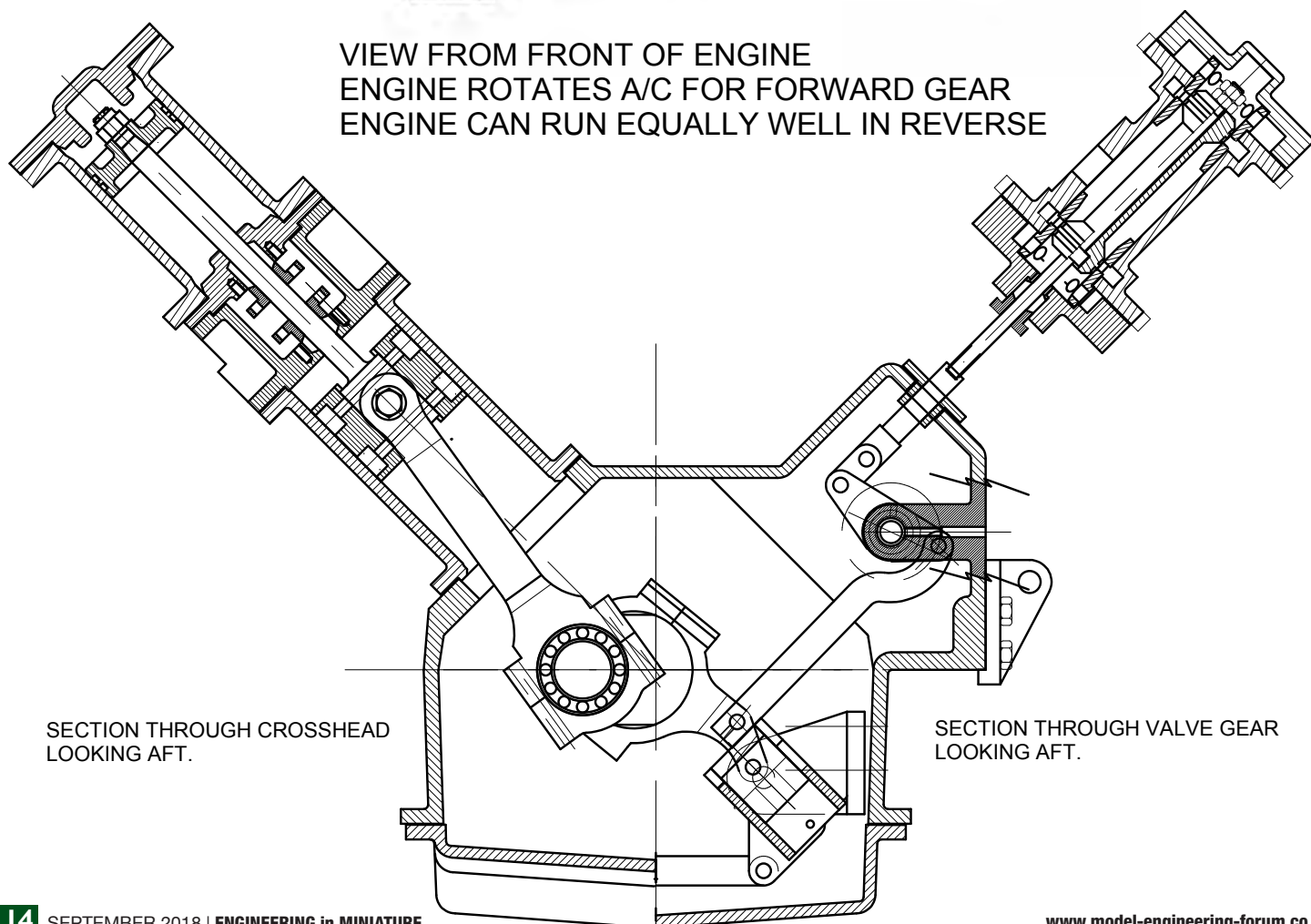
*"I have tried
to reflect
real drawing
office
practice in
that each
component
or assembly
has its own
drawing
and all
components
are listed
on a
parts list..."*

would envisage the gearbox end-plate castings could be used to construct a short 'auxiliaries' drive box for boiler feed, circulating and air pumps and incorporating a thrust bearing block. Clearly, if you want connecting rods glinting in the sun and exposed valve gear, this is not the engine for you. However, if you need an efficient, clean drive unit that can be left outside without rust problems, well it could be what you need. **EIM**

■ The second part of this feature will appear next month and **EIM** will continue to describe this project as the build progresses. You can also follow construction of the chassis online at: www.flickr.com/photos/140734312@N06/sets/72157669955074511

The author can also be contacted via the editorial office.

VIEW FROM FRONT OF ENGINE
ENGINE ROTATES A/C FOR FORWARD GEAR
ENGINE CAN RUN EQUALLY WELL IN REVERSE



SECTION THROUGH CROSSHEAD
LOOKING AFT.

SECTION THROUGH VALVE GEAR
LOOKING AFT.

Slides or Pistons?

Our beginners series considers the two major ways of admitting steam to the cylinders

This month we move away from the boiler and to the next major point in the path of the steam, the cylinders. We will be looking at the cylinders themselves in detail later in the series but this month we will focus on something that often confuses novices – the two major types of valves, the devices that control the admission of steam into the cylinder and the exhaust out once its work is done.

These valves are mounted either between or on the top of the cylinders within what are known as the steamchests, and are controlled by part of the motion – another subject for a later edition. The vast majority of valves are either of slide or piston format – slide valves came first, these being the usual format employed in locomotives built throughout the 19th century, before being gradually superseded by piston valves in later-built engines.

A slide valve is a flat, boxed-shape casting that moves over the ports cut into the wall of the cylinder, alternatively opening and closing those ports and letting steam in and out of the cylinder – steam is admitted from the outside of the valve, the process known (not surprisingly) as outside admission.

The D-valve

You will also hear the slide valve referred to as a D-valve, because if you cut it in half the inside profile of the casting loosely resembles the letter D. Its interior forms a chamber for steam to collect in as it is exhausted from the cylinder. From this chamber the exhaust steam passes to the blastpipe and out through the chimney.

The more modern piston valve works in similar fashion to the piston in the cylinder. It consists of two circular heads mounted on a single spindle in a cylindrical steam chest, and these move along the chest opening and closing ports to the cylinder, again letting the steam in and out.

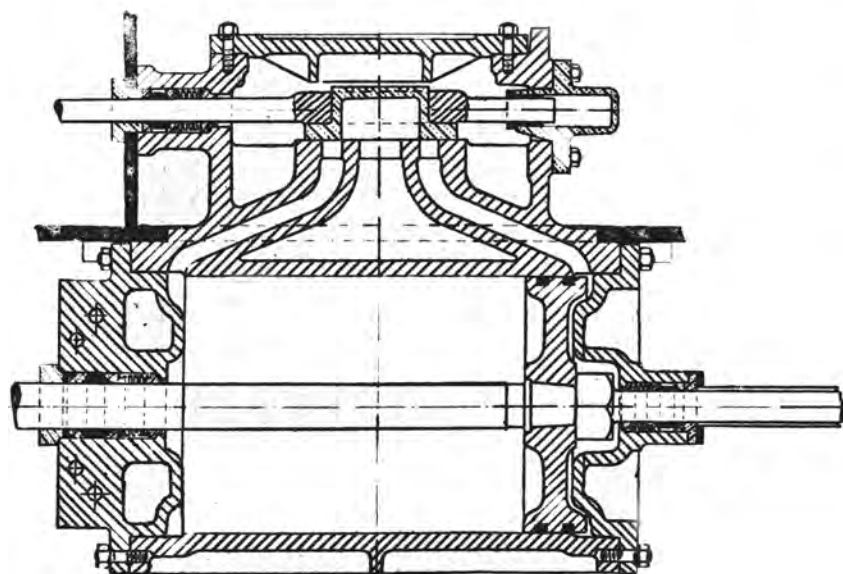
Piston valves are more complex but also regarded as more efficient than slide valves – the pressure acting on one piston balances that of the other, and so these valves can be more accurately set.

Outside admission piston valves are possible but generally they are of inside admission, injecting the steam between the pistons. This works well

RIGHT: There are clear differences between the cross-section of a slide-valve cylinder...

BOTTOM RIGHT: ...and a piston-valve variant.

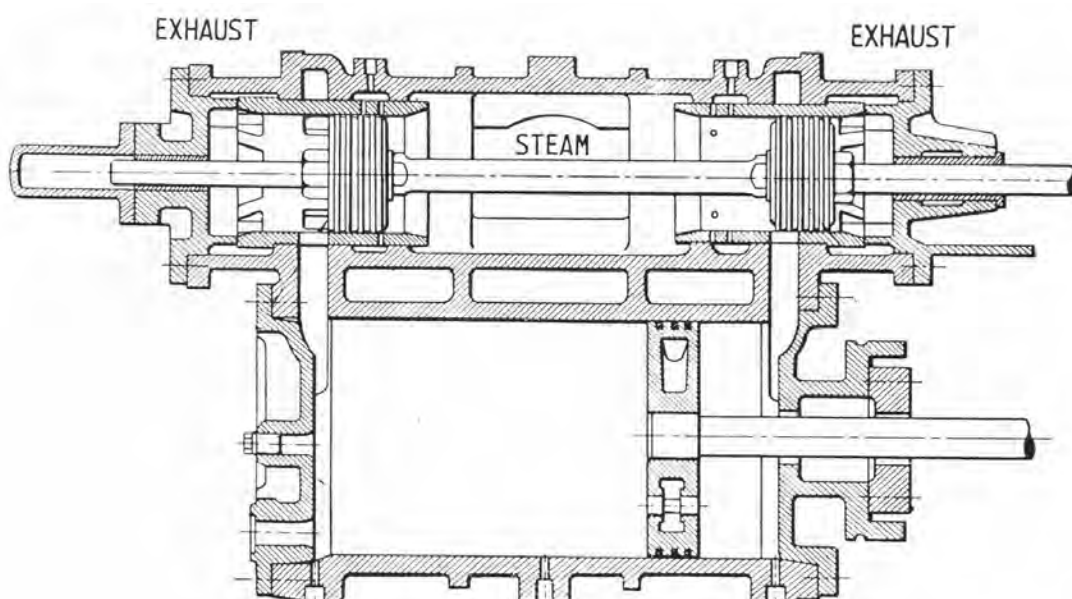
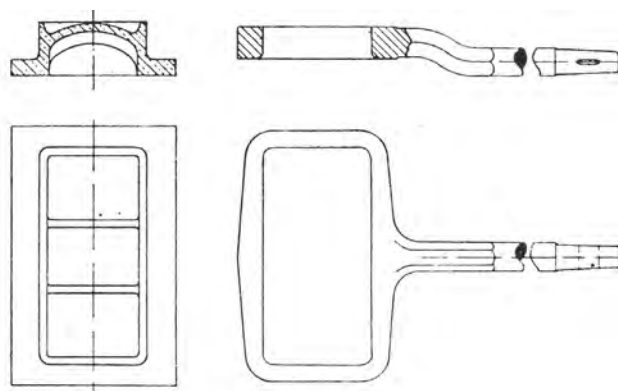
BELOW RIGHT: A view of the slide valve from above reveals why it is also called a D-valve.



with superheated steam, as the higher pressures in an outside admission design would place great strain on the point where the valve spindle exits the steam chest, known as a stuffing box. In an inside admission design the stuffing box is exposed only to low-pressure exhaust steam.

Generally piston valves are a more complex design than the slide valve and overall the latter design was used by more locomotives.

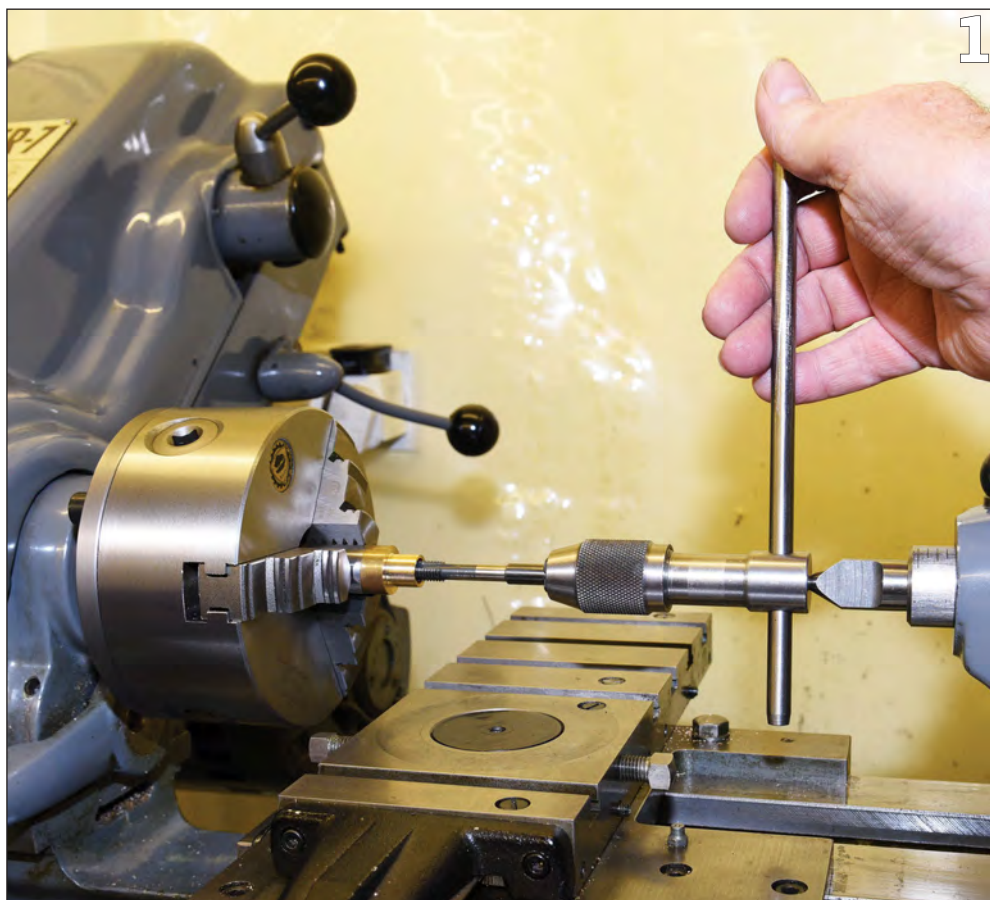
We said the vast majority of valves were slide or piston. There is a third, the poppet valve, fitted to later BR standard engines, and we'll look at these in a later issue. **EIM**



Tips for top tapping

John continues his series of best practice techniques by cutting a thread...

BY JOHN SMITH



1

The first necessity when tapping is to ensure that the tap is coaxial with the hole to be threaded. In the lathe, this is easy to achieve. For many years I used Moore & Wright T-handle, chuck-type tap wrenches. These can be supported on a tailstock centre and will give good results (Photo 1). I believe that these are still available from Eclipse and other manufacturers.

To use them, put the lathe in back gear so that the chuck does not rotate, twist the tap holder half a turn while turning the tailstock hand-wheel to keep the centre engaged.

I then bought an Arrand threading attachment (Photo 2) which features a 2MT shank, to fit the lathe tailstock, and a $\frac{5}{8}$ in diameter spigot. A carrier or body is provided, to which a number of different die holders can be bolted. A chuck holder and a small chuck to hold taps is also provided.

I purchased an additional body and chuck holder to which I attached a $\frac{1}{2}$ in/13mm drill chuck for cutting larger threads; this is the body on the right in Photo 2. I never use the attachment under power; I am happier cutting threads by hand. Put the lathe into back gear and pull the lathe belt by hand to turn the workpiece after each cut of the tap or die.

Squares and rectangles

These threading attachments are excellent, but most of the holes we need to tap are not on the centreline of the lathe, so we need a means of holding taps coaxial with holes when we are tapping holes in rectangular components, bar and plate. It can be done by eye, but that is not a wholly satisfactory method.

Photo 3 shows the simple attachment you need to transform your drilling machine and lathe threading attachment into a sensitive, hand-operated tapping machine. The attachment takes just a few minutes to make, but you will use it time and time again.

Photo 4 shows the attachment in operation. Use your precision 'tapping machine' for cutting the first 3 or 4 threads only, then transfer the work to the vice and use a traditional chuck-type tap wrench.

When tapping, we have to remove the tap occasionally to clear swarf from the flutes of the tap. Failure to do



2

this can cause damaged threads, taps which become stuck and even broken taps. When you tap, advance the tap half a turn, then reverse it for one turn to break the swarf and bring it back to the point where the tap begins to cut again. Repeat this sequence for three or four turns before removing the tap from the hole for cleaning.

Swarf must also be removed from a die during the cutting of a thread. A cutting fluid is helpful. I have found that Treflex works well for threads of 6mm or larger. For smaller threads I use Dormer Super Cut.

Plumbing the depths

Now to the topic of 'depth of thread'. Most engineers' reference tables will give one size of tapping drill, but not necessarily the same size. For example for M6 x 1.0mm ISO metric coarse, some tables specify 5.0mm as the tapping drill for mild steel and some specify 5.1mm. In fact, there is no one correct tapping drill. It depends on the material and the quality of work required.

For steel I usually use a depth of thread of 75 per cent; for cast iron 70 per cent; and for brass 80 per cent. With very small threads, and for hard materials such as silver steel, I reduce the depth of thread, to avoid tap breakage. It's a fact that depths of thread of 60 per cent provide more than sufficient strength.

Every thread defined has a major diameter and a minor diameter. For example, an M6 x 1.0mm ISO metric coarse thread has a major diameter of 6.00mm and a minor diameter of 4.884mm. The percentage depth of thread (D) is calculated as:

$$D = ((D_{\text{major}} - D_{\text{tapping}}) / (D_{\text{major}} - D_{\text{minor}})) \times 100 \text{ per cent}$$

It's a bit of a nuisance to have to calculate the drill size needed for a specific depth of thread. It will probably turn out to be a size like 5.05mm, which you will have to order in specifically.

To avoid all this nonsense, can I recommend a book? It's the *Guide to World Screw Threads*, edited by P A Sidders and published by Industrial Press Inc, ISBN: 0-89381-1092-9. Not only does this book carry full details of any thread we are likely to come across (including BA and ME threads), it also gives nut and bolt dimensions and tables of tapping sizes.

For example, for M6 x 1.0mm ISO metric coarse, it offers the following tapping drill sizes, each with the corresponding depth of thread: 4.8mm (98%); 4.9mm (90%); 5.0mm (82%); 5.1mm (73%); 5.2mm (65%). This saves an awful lot of time.

On the subject of how deep the tapped hole must be for acceptable strength, most experts advise that the

PHOTO 1:

Using a tailstock centre to carry out accurate tapping in the lathe.

PHOTO 2:

A threading attachment adds more versatility.

PHOTO 3:

This simple attachment enables the threading attachment to be used with a drilling machine.

PHOTO 4:

The threading attachment in use on the drilling machine.

All photos by John Smith



depth of the threaded hole for mild steel should be at least 1.0 times the major diameter; that for cast iron, brass or phosphor bronze should be at least 1.5 times the major diameter; and that for aluminium should be at least 2.0 times the major diameter. I generally make the threads as deep as possible, whilst realising that this does not increase the strength of the fixing by very much at all.

Should a tap break in a component in which you have invested a lot of

time, a friendly local engineering firm with a spark erosion machine will be able to cut the tap out without damaging the threaded hole. **EIM**

NEXT MONTH – MILLING

John's Tips for Model Engineers have appeared every month in **EIM** since March 2018. For digital or printed back numbers go to www.world-of-railways.co.uk/engineering-in-miniature/store/back-issues/ or call 01778 392484.



A Distinguished Gentleman

After much planning Mike commences the build of his 5-inch gauge London & North Western Railway Claughton 4-6-0 No. 650 'Lord Rathmore', beginning with the frames.

BY MIKE WHEELWRIGHT – Part Four of Five, Construction

EDITOR'S NOTE: Mike is keen to emphasise that this is not a traditional 'blow-by-blow' account of the loco's construction but a description of what was special about the prototype and how he addressed replicating it in miniature. Included are some drawings, addressing particular areas and prepared strictly for Mike's own use and therefore not necessarily adhering to all conventions!

The original locomotive's frames were designed in two parts overlapping between cylinders and driving axle – I believe this was due to the size constraints of the planing machine at Crewe, but the saws, files and elbow grease in my workshop imposed no limits.

I saw no need to narrow the frame spacing at the front so mine are each a single 1/8-inch plate and merit no further comment. Stretchers were silver soldered from plate and more or less followed the original arrangement. I assumed that the usual front-heaviness in our gauges would be a particular problem with four cylinders so I made sure to put a bit of ballast at the back in the form of a drag box fashioned from a lump of steel that I had acquired somewhere in the past (you know, just in case!).

The middle and trailing horn keeps were connected across the frames by hinged stays following LNWR practice. I cheated a bit with the 'bogie' as the full-size engine did not have one, officially it had a 'double radial truck'.

To all intents and purpose this was a normal Adams bogie but instead of rotating about a central vertical pin it slid sideways in curved guides. Webb

ABOVE RIGHT:

Mike's LNWR Claughton.
Photo: David Baldwin

BELOW: The chassis of the Claughton, with the 'double radial truck' to the fore.

All uncredited photos and drawings by Mike Wheelwright



had pontificated extensively in support of radial axles vs bogies (he held a patent for a radial truck), a position difficult to abandon without losing face, so when the inevitable happened and four wheels at the front of an engine were eventually required it was known at Crewe as a double radial truck.

Although the 'Etna' plans showed the correct truck I felt happier knowing that my pride and joy would be guided into curves by an Adams bogie complete with several pounds of side-control spring force. They really do work well if properly loaded.

Coupled axleboxes were based on what I had seen on various models, being split on the horizontal centreline. The lower part of each cast-iron box was machined away beneath the axle and replaced by a brass block held by steel pins pushed in through the sides. The bearing holes were bored half in each material then the brass keeps were removed and

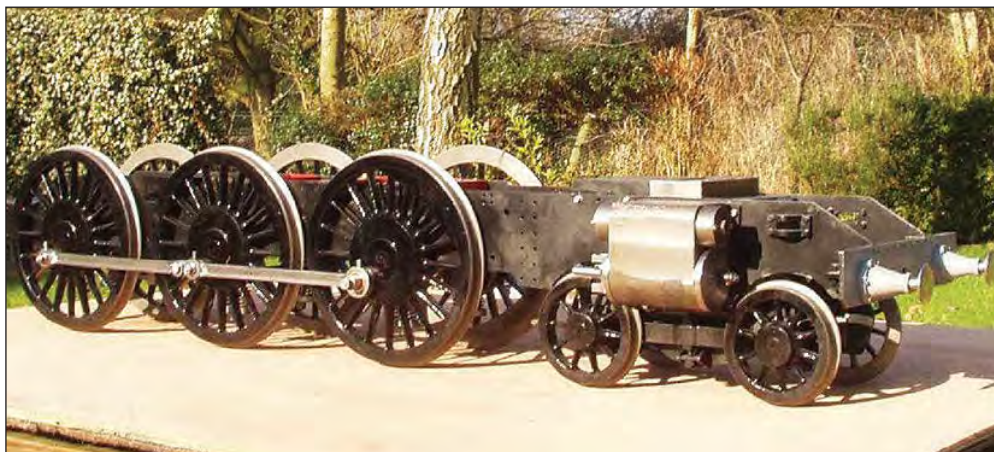
small recesses were machined in the bottom to accommodate scraps of felt.

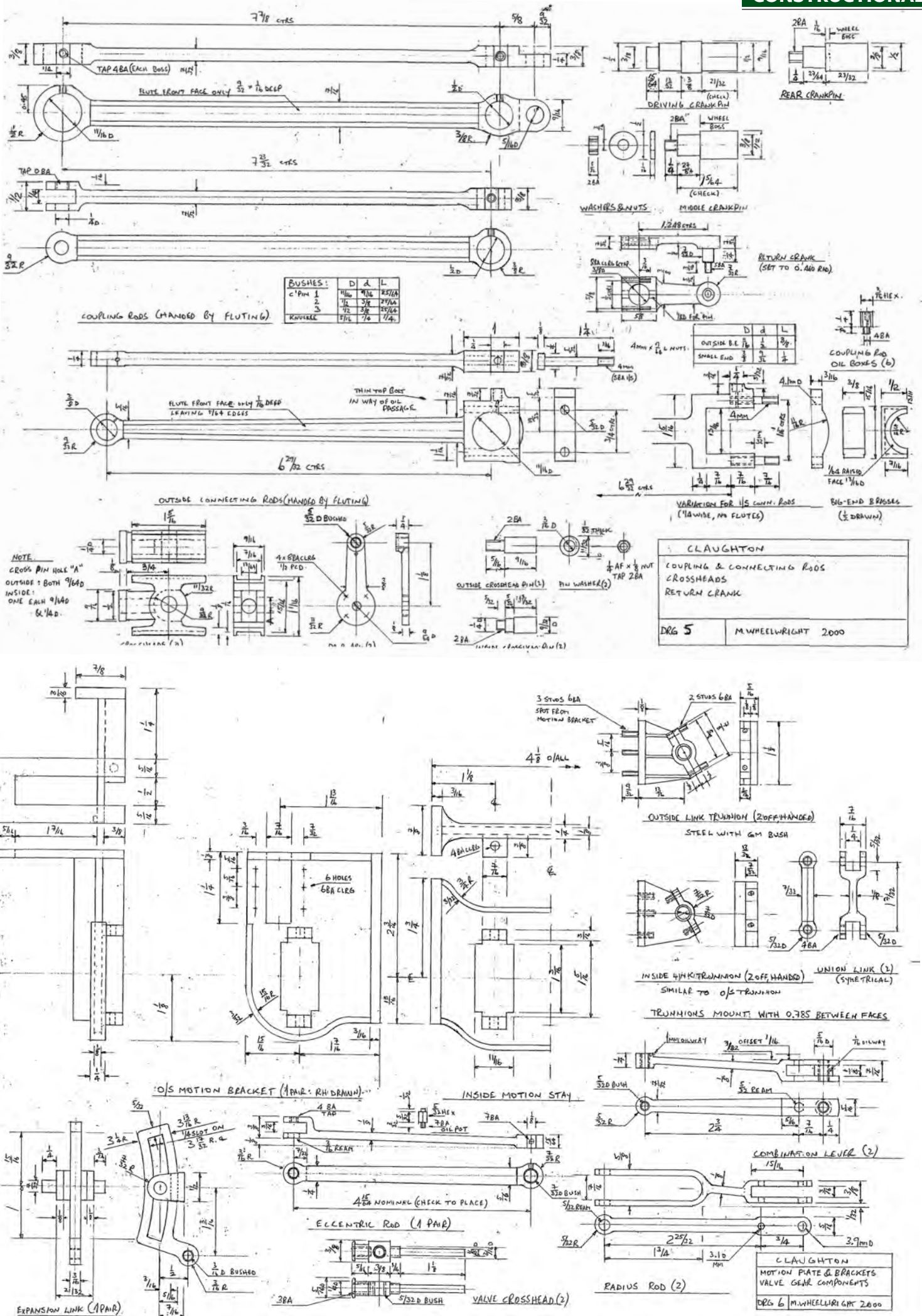
This is a simplified copy of the Swindon horse hair and spring arrangement in which oil is retained and swept up by the rotating axle. I have used this on other heavy haulers and on the odd occasion when axleboxes have been removed they showed no discernible wear.

Brass is of course a satisfactory material for keeps as the load is taken on the upper cast-iron surface of the box. The felt pads are charged with oil though the axle centres and small cross holes in line with the keeps, one squirt per run does the job. Oil boxes just inside the frames feed the sliding faces of the axleboxes, the rear ones are under the cab floor and have steel pipes passing between the frames and firebox, I remembered that the rear boxes of the big Claughtons suffered greatly due to pipes getting crushed.

Springing broadly followed the prototype with a pair of helical springs under each axlebox of the front axles and leaf springs at the back. The official general arrangement showed this arrangement but the drawing in *The Engineer* had compression springs for all axles and this also appears in a photo of a later engine in the works in LMS days.

I spent hours looking for photographic evidence when the engines were new and I found one picture taken low down with the sun shining through the wheels in which leaf springs at the back can be seen, good enough for me. I think riding would be a bit lively without any leaf springs to dampen out rolling at the







back. As the springs are almost invisible I used just a few leaves of spring steel to give me the deflection required without putting in dummies, Tufnol was out of the question with the ashpan for a neighbour.

Manufacture of the wheels was quite straightforward once in possession of the proper castings, more so since it was Don's custom to simplify castings by supplying them without balance weights (the balance for driving and coupled wheels is usually different).

I used car body filler to put in the

correct pattern of balance weight for each wheel without the chore of filing out the one supplied. I expect everybody knows that in $\frac{1}{12}$ th scale real balance weights are unnecessary: mass goes down by a factor of 12^3 and acceleration falls by 12 so the forces to be balanced are only $1/20,000$ of the full size.

Actually it was not easy to find out the shape of the weights, all posed photos were 'rods down' with balance weights hidden under the plating and action photos were usually too indistinct, only an amateur's picture

"I think riding would be a bit lively without any leaf springs to dampen out the rolling at the back..."

of an engine left at random would do. Luckily I found one, eventually.

The coupling rod throw of the prototypes was 12 inches with the connecting rod at 13 inches so driving cranks were eccentric, I compromised by having everything at $1\frac{1}{8}$ in radius and found the extra $\frac{1}{16}$ in no problem in the big wheel centre. Following my usual practice I fitted the return cranks as soon as the driving wheels had been finished and then Loctited the crankpins into the wheels using a simple jig to set the correct angular position of the return crank pin relative to the main crank. After removing the jig things were made permanent with a pin from the back halfway into the wheel.

Cylinders and Valves

Having put in overtime designing the cylinders their manufacture was uneventful, just one pair of typical outside cylinders and one inside cylinder block. The valve liners of cast iron were in two parts pushed in until they met, this simplifies inserting the valve heads with their rings.

My machining skills are definitely amateur and I make parts to fit each other (do I hear tut-tut?). Obviously a special effort was needed with bores as I was using standard-size rings but the actual distances of the steam edges of the ports from each outside face was accurately measured and recorded before assembly with each liner being numbered (1F, 1B ... 4B). Knowing the distance of the port edges from the datum surfaces was vital in centralising valves easily so the figures are not only kept with the drawings but a copy is filed with important household documents, just in case. Liners were a light push fit assembled with Loctite and fixed with $\frac{3}{32}$ in pins.

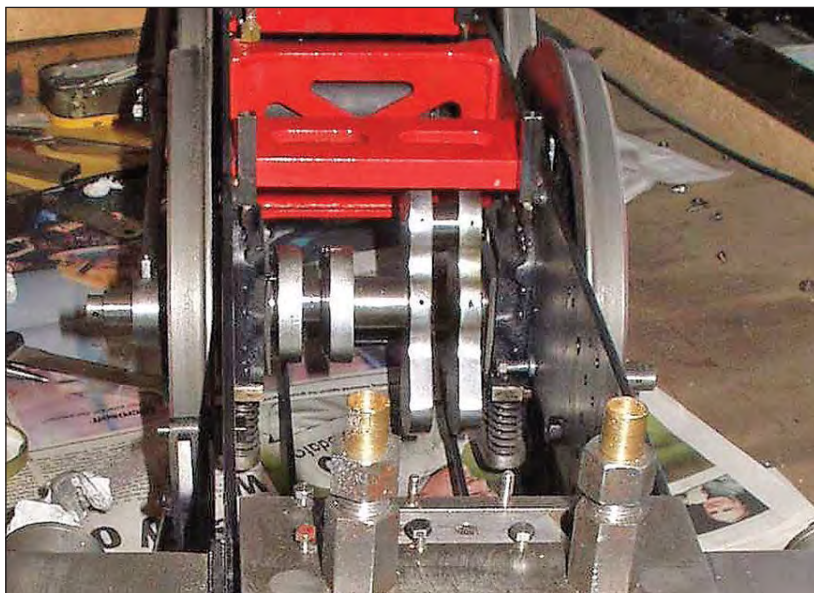
The manufacture of the valve gear was also straightforward as there is nothing unusual about it. When marking out the frames I had put in a small hole on the centre line of the expansion link bearings, this was used to locate the centres of the trunnions supporting the expansion link so the correct positioning of the link was assured. I left the finished length of the eccentric rod until the moment of assembly of the valve gear when it was quite easy to determine it correctly for each one.

The expansion link is clamped at mid-swing, in other words. the radius rod can be run forward-to-reverse with zero movement at the combination lever, and the motion is set to Front Dead Centre, the centre distance from return crank to link drive hole is measured and the whole is repeated for the wheels at BDC, made even easier by using a telescopic dummy eccentric rod with which I

ABOVE LEFT:

View from above the frames, with the stretchers in view.

LEFT: Close-up view of the driving crank.



have previously set up several engines.

If the return crank has been set to the correct angle vis-à-vis the main crankpin the distances at FDC and BDC will be the same, in practice by using the crank setting procedure mentioned a difference of less than $\frac{1}{32}$ in ought to be achieved, and the rod proper is made to the mean length. Once this has been done there is only one possible setting remaining – centralising the valves to the steam ports, I chose to go for equal leads.

Peering down sighting holes is not for me, it's easier to use a Vernier depth gauge between the front face of the valve liner and the front of the bobbin. Adding the width of the valve head to the 'depth' of the front face of the bobbin tells me where the steam edge of the head is, a comparison of this with the recorded position of the steam edge of the port shows how much steam opening (or steam lap) there is.

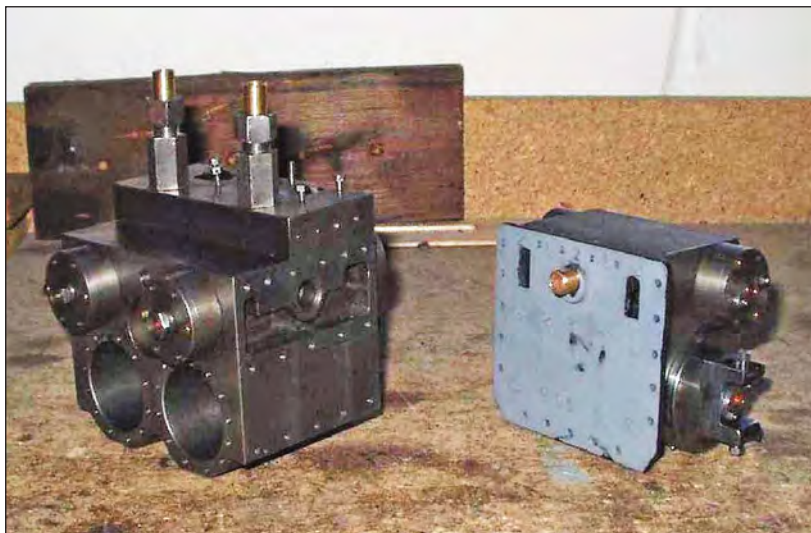
The position of the other steam face is calculated knowing the bobbin separation so openings at each end can be compared and the setting of the valve on the spindle arranged to give equal leads. I held my breath while checking if the leads and full gear openings were as expected, it is an interesting moment. I have yet to be disappointed with the result.

Testing on Air

With motion assembled and valve gear adjusted comes the moment of truth: do the wheels go round? I usually pack the axleboxes to working height, put a bit of compressed air into the steam pipe and see what happens, actually it is somewhat more complicated with a multi-cylinder locomotive but not especially so with the Claughton.

The inside valves are driven from the outside valve gear and it seemed pointless to deal with them until the

"My method of setting everything to calculated angles and lengths does require getting everything 'right first time'..."



ABOVE RIGHT:

The cylinders took a lot of designing but very little manufacturing.

RIGHT:

Another view between the frames with the motion complete.

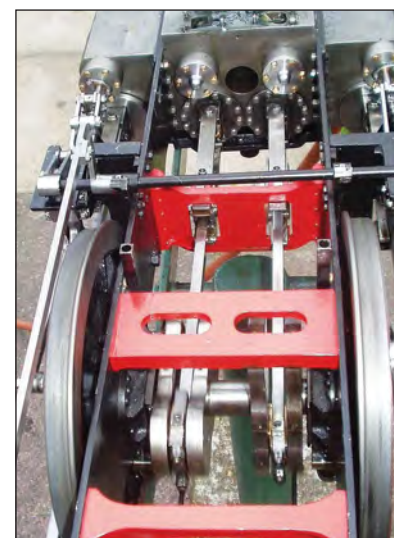
BELOW:

It all works! The chassis being tested on compressed air.

outside motion had been checked so I dismantled the inside motion and clamped the valves in mid-position, i.e. ports lapped, and I also restrained the piston rods from moving. Then I tested the engine on air just like a two-cylinder version, everything was satisfactory and it ran for a couple of hours lifted above the rails: it rocked away steadily like they all do.

Of course with virtually nothing capable of being 'reset' I would have been in trouble if things had not been correct, my method of setting everything to calculated angles and lengths does require getting everything 'right first time'.

Satisfied with the outside setting I reassembled the inside motion and centred the valves. The engine then resumed its running in on air but with the noticeable difference that it no longer rocked back and forth: of course the adjacent motions at 180 degrees to each other were in balance, it was a good demonstration of why the Great Western Railway's chief mechanical engineer Churchward turned away from his policy of two cylinders at least for his Saint express engines, and



accepted the complication of four cylinders on the Stars. **EIM**

■ The first three parts of this series appeared in the June, July and August 2018 issues of **EIM**. Digital copies can be downloaded or printed versions ordered from; www.world-of-railways.co.uk/engineering-in-miniature/store/back-issues/ or from 01778 392484.



Refurbishing clock pivots

Mark reveals a vital maintenance and repair task to keep a clock running smoothly.

BY MARK BROCKLEY

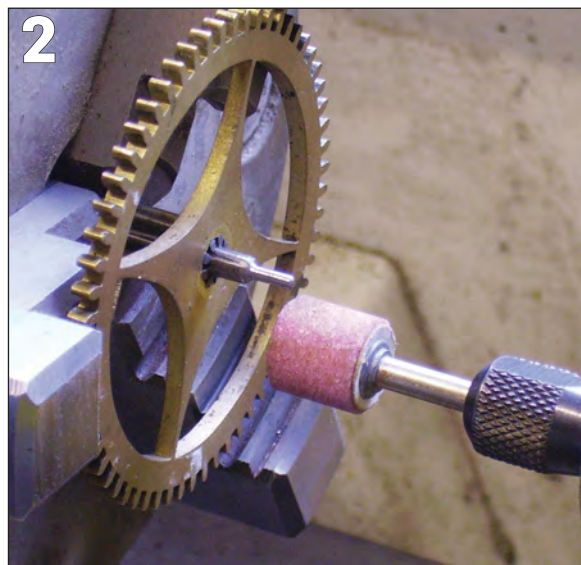
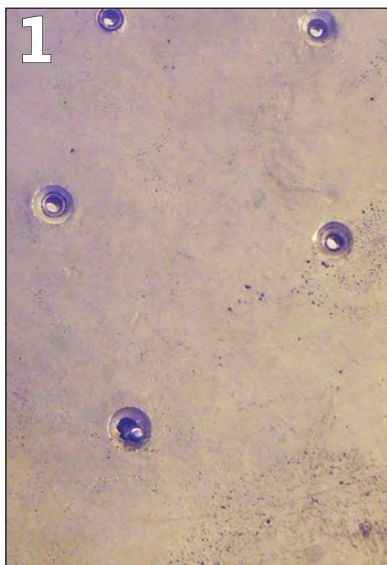


PHOTO 1: An example of pivot wear – a pile of brass at the base of the clock is a major clue.

PHOTO 2: The pivot is ground using a Dremel and a lathe.

PHOTO 3: This picture shows the setup for mounting the Dremel in the lathe toolpost.

One of the most critical parts in a clock that aid its smooth running are its pivots. They need to be parallel and polished to a mirror finish. After time the combination of pivot oil, dust and fine particles of brass and steel (from the pivots and clock plates) all act as a grinding paste and wear the pivots as well as the clock plates.

The quality of the original pivot will determine the amount of refinishing that will be required. Old English clocks have generally good quality steel used in them and of a suitable initial diameter to cope with several good refinishings. I have found that the more modern foreign-made clocks don't take to much refinishing and can then wear out very quickly indeed. Some have been known to only last six months! When this happens a new pivot will be required.

I recently received a call from a client who wanted me to take a look at his long case clock as it kept stopping. I was also informed that there was a neat pile of brass at the base of the rear plate. **Photo 1** shows the reason for this pile of brass, the centre wheel pivot had worn the clock plate by an extreme amount.

Worn and rough

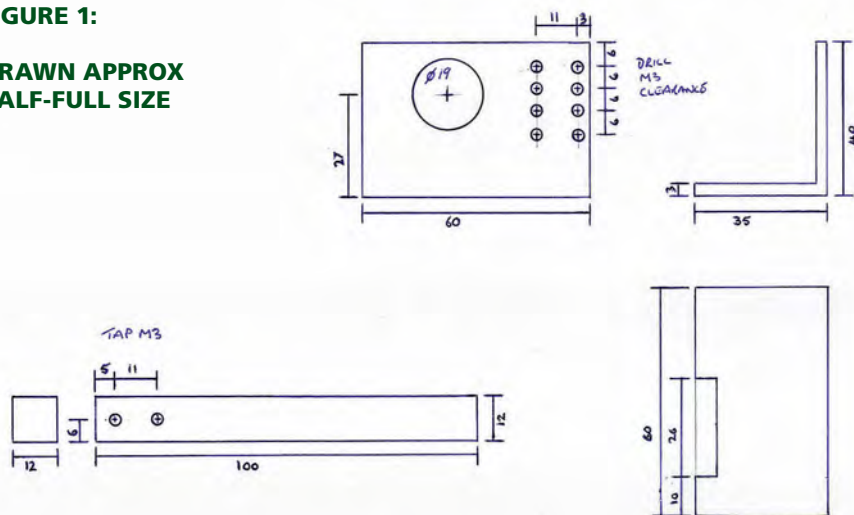
After dismantling the clock the pivot was inspected and found to be worn and extremely rough in places. After setting the wheel up in the lathe chuck so it ran true I then mounted my Dremel multi-tool in the lathe tool post to cylindrically grind the old pivot. **Photo 2** shows the pinion after grinding and **Photo 3** the setup for holding the Dremel in the tool post. This consists of a piece of angle iron and a piece of 12mm square bar. **Figure 1** gives the dimensions and general arrangements for my tool post holding attachment.

After grinding the pivot needs to be finished to a bright mirror finish. **Photo 4** shows my selection of tools used to polish pivots. Item 1 is a selection of home made burnishers, these are thought to be the best way to polish a pivot. They are made from worn-out needle files with the teeth ground off then polished on fine emery cloth.

It is claimed that burnishers harden the pivot as well as polish them. I frankly don't have much luck

FIGURE 1:

**DRAWN APPROX
HALF-FULL SIZE**



with burnishers, I don't feel they give a good finish and can't see how just polishing with the burnisher can harden steel. There are burnishers available commercially however they are of a high price and usually in several grades.

Item 2 is a good quality pillar needle file and used with a little oil can be a good start on a rough pivot (Photo 5). Item 3 is a carborundum stone and used to give the initial polish to my pivots. I prefer to dip it in water before use but it can be used dry. Item 4 is a Water of Ayr stone and must be used with plenty of water. This stone tends to give a fine but dull finish to your pivot.

Item 5 is a rubber block impregnated with carborundum powder and polishes the pivot to a nice bright finish. Items 6 are a piece of oak with leather glued to one edge, and pots of Diamantine polishing powder that is mixed with methylated spirit in small quantities to form a paste. Dip the stick in water and spread a little paste on to the leather and polish.

Item 7 is another oak and leather stick but used with jeweller's rouge powder in exactly the same way as the Diamantine powder (Photo 6).

I forgot to add my final step of pivot polishing tools to the selection photograph – this is a small felt polishing wheel from my box of Dremel accessories (Photo 7). Wet it with a little methylated spirits and buff up the pivot with it.

Clean to keep smooth

I should mention that between each step the pivot should be cleaned of any residue left behind to prevent a coarser polishing agent from contaminating the progressively finer agents and causing scratches in the final finish.

Photo 8 shows the completed pivot after the polishing process. All that is needed now is to reverse the complete wheel assembly in the lathe and support with a lathe runner to polish the front pivot (Photo 9). All that was required to clean this pivot ►

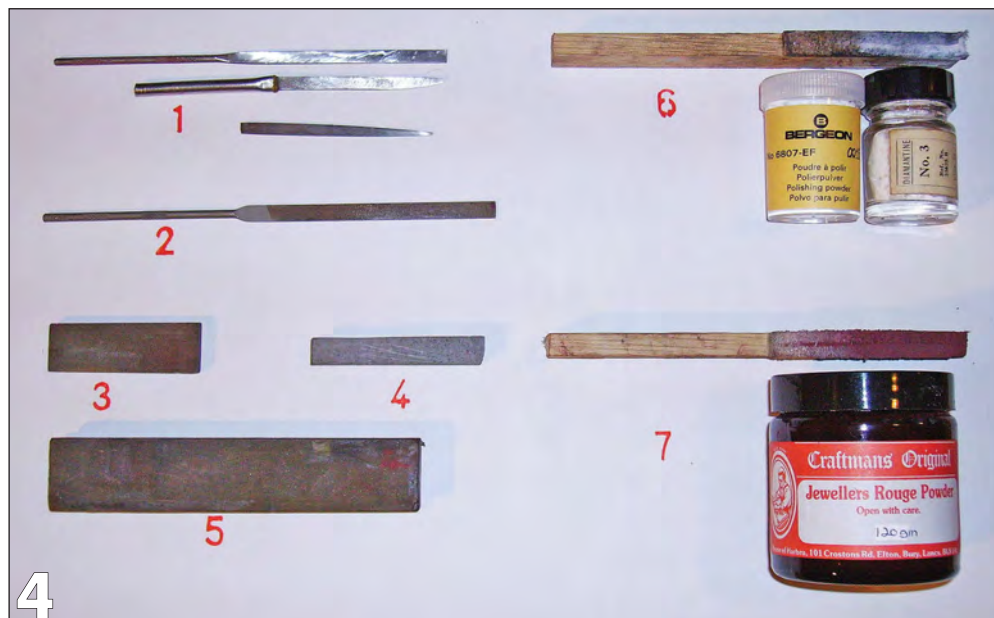


PHOTO 4:

Mark's tool selection for polishing pivots, details in text.

PHOTO 5: A good start is to use a needle file.

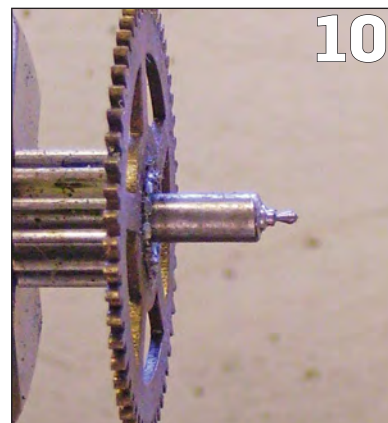
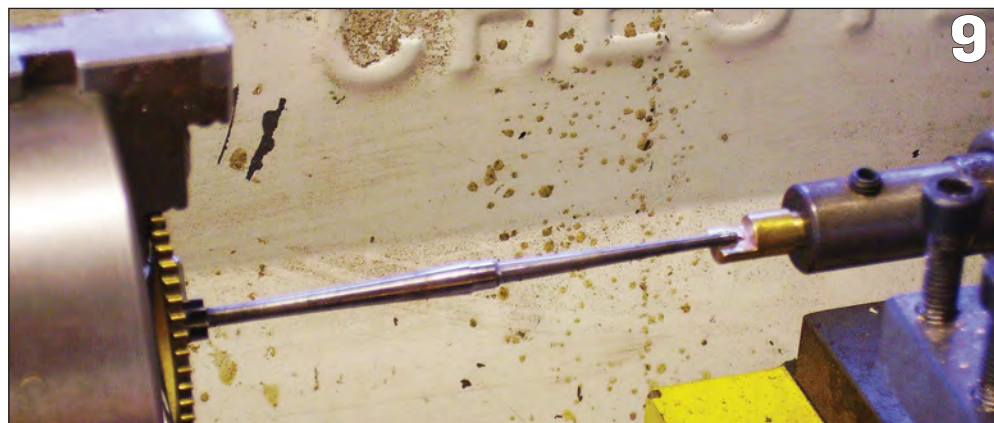
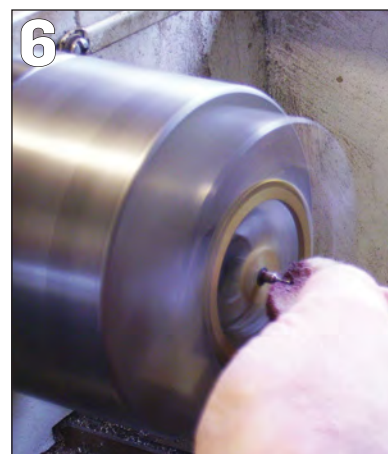
PHOTO 6: Oak and leather stone used with jeweller's rouge.

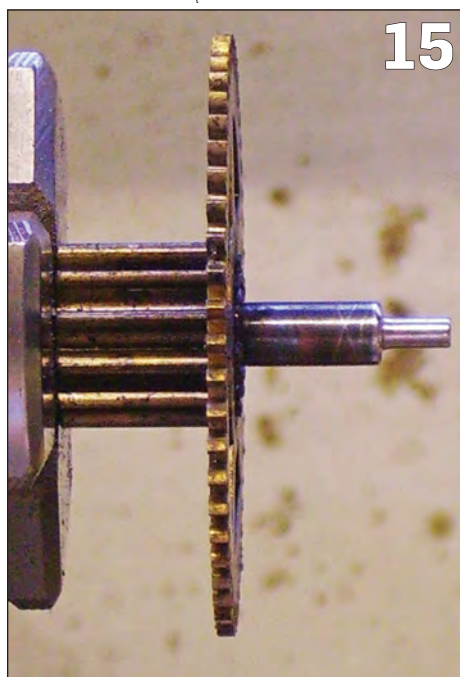
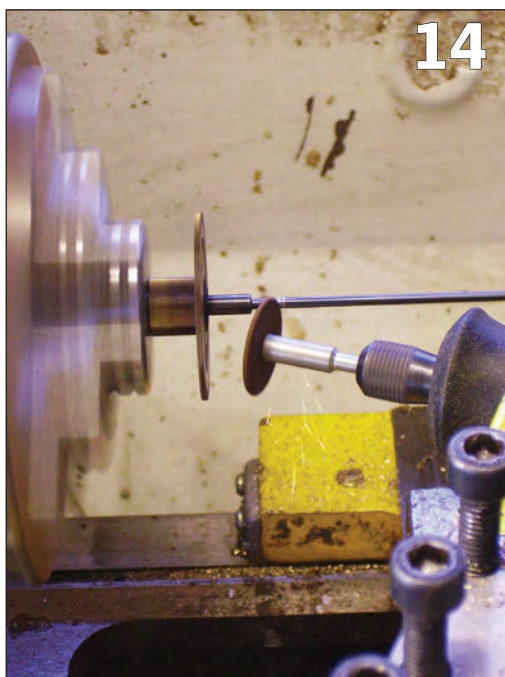
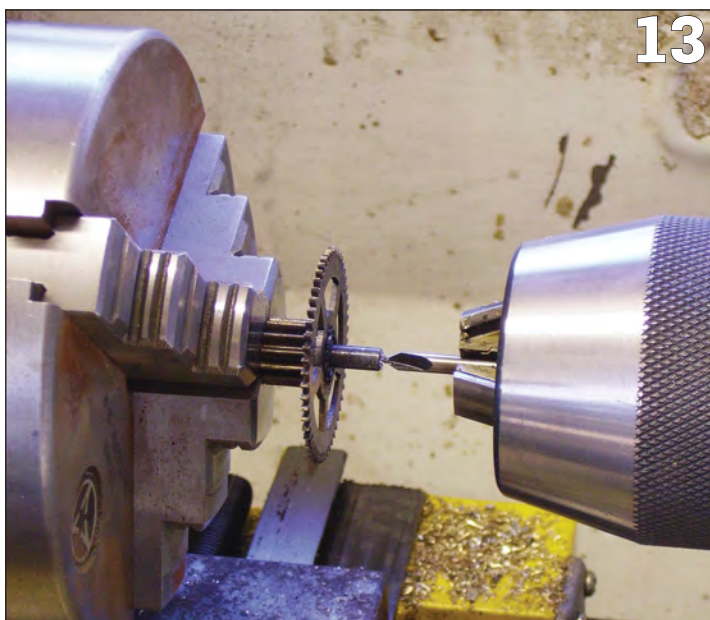
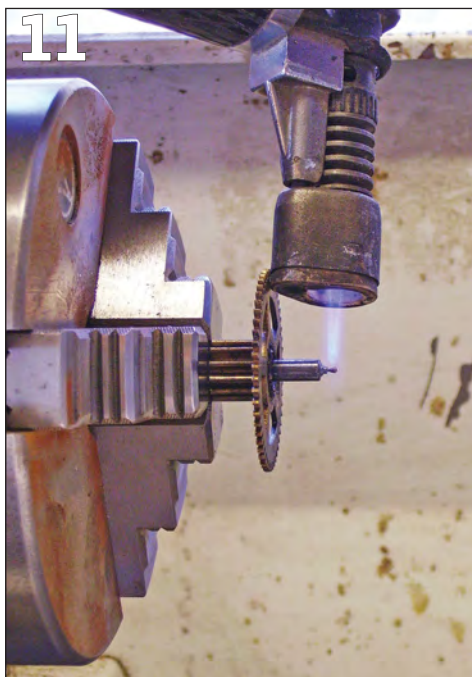
PHOTO 7: A small Dremel felt polishing wheel provides the final touch.

PHOTO 8: The completed pivot after polishing.

PHOTO 9: To polish the front pivot support is needed.

PHOTO 10: If the pivot is as badly worn as this, a new one is required.





up was to start by using the carborundum stone then move on to each of the previously mentioned steps. When this has been done the clock plates can then be re bushed to suit the new pivot sizes.

Making a new pivot

If a pivot is extremely worn as shown in **Photo 10**, there is no substantial metal to dress up and polish so a new pivot will have to be made and fitted to the arbour.

The first step is to anneal the old pivot. I prefer to set the arbour running true in the lathe first as the old pivot helps as a guide to the arbour being central. A small blow torch with a precision flame is ideal to quickly heat the pivot (**Photo 11**). It's important not to transfer heat into the lathe and the use of these lighter re-fill blow lamps are great for this kind of work.

The next step is remove the old pivot after checking its original length and to make sure the shoulder is square (**Photo 12**). Select a small centre drill – 1mm is about the smallest that is available so if the new pivot is 1mm or under it is best to just use the tip of the drill and only put a shallow depression on the cleaned-up arbour as shown in **Photo 13**. Next drill into the arbour with a drill that makes a tight push fit of the pivot steel being used and to a depth of at least twice the finished length on the pivot.

Know the drill

Blued pivot steel is available from a variety of suppliers and is a good investment. However if clocks are not a regular project in your workshop and replacing worn pivots likely to be a problem encountered once in a blue moon, another good source of pivot steel is the end of the drill shank used to drill the arbour.

I know it could be frowned upon to use a drill in this way but 10 to 15mm off the shank won't destroy the drill – it can still be used and the cost of small drills from shows and the internet is fairly reasonable for an occasional repair.

Photo 14 shows pivot steel being cut down to length with the Dremel after it has been fixed into the arbour. Traditionally the new pivot was soldered into the arbour but with the development of Loctite and Super Glues I find these quicker and easier to secure the new pivot.

The new steel should be ground and polished to a bright mirror finish as described earlier in the article.

Photo 15 shows the finished job ready to go back to the clock plates for re bushing, making the clock run like new again. **EIM**

PHOTO 11: Small blow torch is effective for rapid heating of the pivot.

PHOTO 12: Ensure that pivot shoulder is square.

PHOTO 13: Small centre drill used to make a depression in the arbour.

PHOTO 14: Cutting the pivot steel to length using a Dremel.

PHOTO 15: The finished new pivot – it should be polished to a mirror finish before refitting.

All illustrations in this feature by Mark Brockley.

Collapsible storage for rolling stock

Where do you stable those models you've built? Jan-Eric has an answer.

BY JAN-ERIC NYSTRÖM



1

The more rolling stock I've built, the more problematic the storage has become – this is probably a familiar situation to any live steamer...

So, in order to accommodate an accumulating plethora of locos and wagons, I definitely needed something more organised than an occasional, derelict table dragged into the garage! The solution (three of the seven I've built) is seen in **Photo 1**: lightweight, roll-away, collapsible carts.

A quick sketching exercise allowed me to make my inevitable design mistakes on paper instead of in metal; **Photo 2** shows my first (and only) scribbles, with a few crossed-out errors. I used this in the workshop, as is apparent from the smudges and creases! The cleaned-up sketch, drawn later, is for the readers' benefit – I'll refer to it when constructional details are discussed.

As can be seen in both Photo 1 and the sketch, the carts are built entirely from pieces of flat and angle iron. Depending on the weight of your rolling stock, you may have to adjust the dimensions of the material – $\frac{3}{4}$ -inch or 1in scale rolling stock might not need as heavy stock as my 1.5in scale cars, while a heavy locomotive will certainly need more sturdy stuff; 50mm channel iron would be a better choice for the rails than the 30mm angle iron I've used.

PHOTO 1:

Thanks to the compact roll-away carts, it is easy to store the Live Steam rolling stock along the walls or in a corner of a garage or workshop.

PHOTO 2:

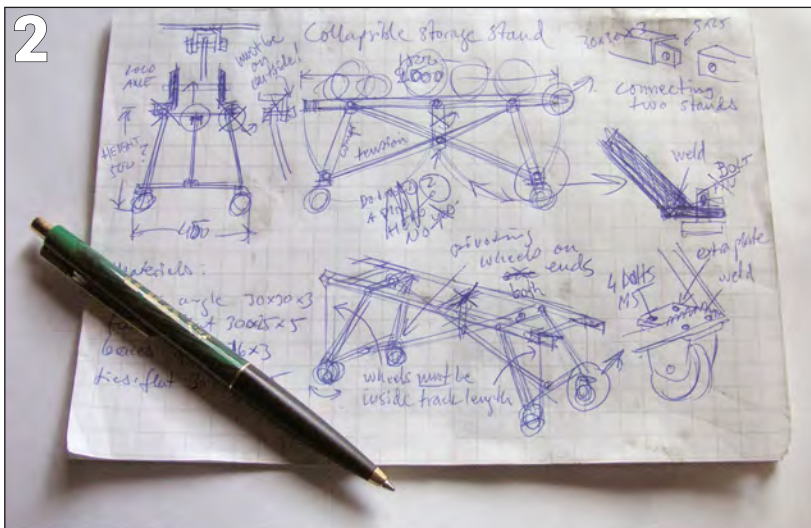
A design for the collapsible storage carts develops from the first quick doodles.

All photos and illustrations in this feature by Jan-Eric Nyström

Looking at the sketch, we see that the cart consists of three main elements; the rail top, grey; the legs, red; and cross braces, green. The choice of materials for these parts must

reflect the forces they will have to stand up against.

Angle and channel iron resist bending, and are therefore ideal for the track. The legs are in compression, and





Notes for builders

■ In order to build carts like these, it is not necessary to have access to a welder; the fastening of the ties between the rails can be accomplished with pieces of angle iron assembled with bolts and locknuts, instead.

The mounting plates for the wheels can also be bolted to the legs, or wider flat iron could be used.

These carts are of course only one solution to my own particular live steam storage problem. This article is intended only as an example, and as inspiration for your own design. Requirements do vary, so for this reason, no exact measurements have been indicated. Adequate strength should always be of prime importance.

Many improvements could also be made to the design – for instance, using wheels with built-in brakes, or adding permanently attached, hinged ‘flip-away’ wheel chocks for securing the rolling stock.

in order for them not to buckle, they must be of sufficient cross section. I’ve used flat, hot rolled iron, 25mm wide and 5mm thick. The cross bracing will only take a tensional load, and can thus be of lighter material – 15mm wide and 3mm thick was quite enough for my needs.

Building the carts

First, the track top – as mentioned, I used angle iron, but I also needed ‘ties’ between them. The same flat iron used for the legs is strong enough, and two pieces were formed so that when welded between the pieces of angle, the distance between the angles corresponded to the track gauge (7¼-inch in my case).

It is necessary to shape these ties so that the wheel flanges won’t be obstructed; the blue arrows in the sketch show the two cut-outs needed.

Also note that the ties have chamfered corners; the inside of hot-rolled angle iron is never square, it has a small radius. By cutting away the top corners of the ties, they will fit all the way into the angle. Small ‘forks’ made of two short pieces of flat iron, and a bolt and nut function as hinges for the cross braces (green arrows in the sketch).

The construction of one of the ties and its hinge is seen in **Photo 3**. Since there is no sideways force when the rolling stock is simply pushed onto the track, two ties are enough.

Originally, I had planned to have one central tie, possibly with a downward-pointing brace attached to the cross braces, but this proved to be unnecessary – the angle iron tracks are sturdy enough, they can even take the weight of two adults sitting on the cart, without any significant flex.

The legs are made from three

pieces of flat iron each. The two vertical parts are bent near the top and welded to the ‘foot’, forming a trapezoidal shape. This strengthens them; straight legs would be more prone to bending or buckling sideways.

In addition, the legs tilt outward by ten degrees; this, in combination with the cross bracing, avoids having them wiggling lengthwise. All in all, using angled elements throughout makes the design more rigid.

Protracting...

It is of course important that the chosen angles are adhered to properly; all angles should be identical, otherwise the cart will be very skewed and ugly...

I happened to have a protractor available, and using this, it was easy to cut and weld everything correctly.

Photo 4 shows how I checked that the flat iron for the legs was properly cut. The scale shows 80 degrees, even though the actual angle being measured is 100 degrees. This is because most protractors have scales going from zero to 90, and then back down to zero again.

Fastening the legs to the rails, using bolts and locknuts, I could again check that the angle was correct, **Photo 5**. This ensures that the rails and the feet will be parallel.

The feet are made of the same flat iron as the legs, with a couple of extra pieces welded to the ends, to form a wide enough area for the attachment

PHOTO 3:

One of the ties – note cut-outs for wheel flanges.

PHOTO 4:

Protractor used to check cuts made at the correct angle.

PHOTO 5:

Protractor also sets and checks angle when welding legs.

PHOTO 6:

Cross brace welded to small tab attached with a single bolt to one leg of the cart.

PHOTO 7:

Wheel attached with bolts and washers to welded leg extension plate.

PHOTO 8:

Collapsed cart is less than 100mm high, lightweight and easy to transport.



of the wheels. Or, you could use larger pieces of steel plate, if you wish.

The cross braces were marked and cut while the legs were in their correct, final position, and then welded to small tabs bolted to the middle of each leg in their final position, **Photo 6**. These tabs are marked with red arrows in the sketch.

I was fortunate to find swiveling industrial cart wheels, 75mm in diameter, costing no more than £2.50 apiece – a real bargain! These were attached to the feet of the carts with four bolts each, **Photo 7**. Due to the surprisingly large holes in the wheels' mounting plates, washers were needed.

With all four wheels attached, the cart was finished! By unscrewing just the two cross brace bolts from the feet, it collapses to less than 100mm high, **Photo 8**, so several carts can be stored in a relatively small space, and, if necessary, transported together with the rolling stock.

Opening up the 'package' and attaching the cross braces to the feet works best if the cart is upside-down, as in **Photo 9**. Since it weighs only a few pounds, it is easy to turn the cart around, **Photo 10**, after which it is ready to accept its load, as in **Photo 1**.

Securing the load

One more important thing: the load must somehow be prevented from rolling off the cart when it is moved around, especially if the rolling stock has no brakes.

This is easily accomplished, either by using some form of clamps, clipped to the rails, or by simple wheel chocks. An example of the ones I made is shown in **Photo 11** – at least two of these are needed, on each side of a wheel, as in **Photo 12**. The chocks have triangular pieces welded on top, and short lugs, i.e. pieces of flat iron welded to the bottom of a strip that spans the width of the track.

The chocks are positioned with their lugs between the rails. If you intend to attend a rally with the cart, you'd better also have some way of securing the chocks to the rails – but for normal moving around in a garage or workshop, the loosely placed chocks have been good enough.

With these rollaway carts, I have solved my storage problem! But you may ask why I built them at all – can't I just store my rolling stock on the garage floor?

Of course I could, but these carts have a definite purpose: they enable me to move my live steam equipment around, and into the boot of my car, or onto a trailer without having to lift anything! The whole idea is to store the rolling stock at the same height as the floor of a trailer or the boot of a minivan, as seen in **Photo 13**. **EIM**

8



PHOTO 9:
Opening up the 'package'.



PHOTO 10:
Turned the right way up, and ready for use.



PHOTO 11:
A simple wheel chock, welded from pieces of flat iron.

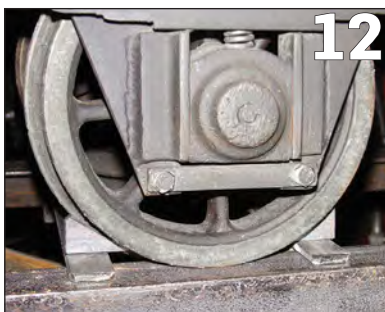


PHOTO 12:
Two chocks slipped in between the rails and under a wheel prevent rolling off.

PHOTO 13:
Loading rolling stock into a car or onto a trailer is easy and requires no lifting. A simple collapsible ramp spans the distance between the cart and trailer.



13



A new museum for the Ravenglass line

Mark describes several developments on this most evocative of 15-inch gauge operations.

BY MARK SMITHERS



1

The last five years have seen important developments on the 15-inch gauge Ravenglass and Eskdale Railway – some as a result of the fire of 28th March 2013, which destroyed the line's workshop and damaged much of the equipment within, including components of the then under-overhaul locomotive 'River Esk'. Other additions and improvements have been undertaken to assist the railway in maintaining and consolidating its position as an important regional heritage attraction.

Probably the most noticeable of all

of the recent developments has been the building of a new museum. The original museum at Ravenglass station was established in 1978 adjacent to the 'up' platform. By 2014, it was felt that this building was showing its age and that a replacement was required.

A Museum Management Committee, comprising representatives of the railway Company, the R&ER Preservation Society and the Eskdale Cumbria Trust was established to oversee the project and source suitable funding. In this latter connection a successful application was made to the

PHOTO 1:

The improved museum is now a fine venue for exhibitions, such as this one of Bassett-Lowke locos.

Photo: Gigantic locomotive Co

PHOTO 2:

The museum features displays covering the R&ER's history right back to the line's opening as a 3ft. gauge system in 1875. Fragments of the equipment associated with this period of granite mining, comprising rails, incline pulleys (ex-Nab Gill) and a 2ft gauge wagon, have survived and are illustrated here.

All photos by Mark Smithers unless stated.

Heritage Lottery Fund for assistance.

The display and interpretation sphere of the project was seen as an ideal function for the R&ERPS. There was a desire to incorporate interactive exhibits and avoid any hint of the 'dumbing down' that it was felt had crept into other similar projects.

By late 2015, an advertisement had been placed for the appointment of a project and activities manager to oversee construction of a new train shed in which to display the exhibits, along with the necessary detailed design and interpretation work inside the building once construction work was complete. Additionally, the manager's responsibilities would include organising a volunteer and activities programme to run the museum after its opening.

Throughout 2016, much time was spent on getting the exhibits ready for their new home. This included the restoration of a Theakston four-wheel granite wagon to a suitable display condition and sectioning, sand-blasting and priming of River Esk's original boiler in readiness for its use in the production of a new interactive display demonstrating the modus operandi of the steam loco boiler.

By September 2016, site clearance was in progress and on 31st October 2016, construction work began in



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earnest. The building's steel frame was completed on 25th November, whilst the roof had been erected by 16th December. Construction continued steadily during the early months of 2017 and by the end of April all of the internal track had been installed and its surrounding concrete laid.

On 12th-13th June Headland Design Ltd installed the new displays and on 14th June the project saw an important milestone with the arrival, from Station Road Steam Ltd of Metherington, Lincs, of reconstructed Heywood 0-4-0T 'Katie'. Some ten days later, the new museum was opened to the public by Paul Atterbury, railway author and star of the BBC's *Antiques Roadshow*.

Wide ranging

The new museum includes a wide range of exhibits covering the line's history, from its period of operation as a 3ft gauge system from 1875 to 1913, through the pre-preservation 15-inch gauge era from 1915 to 1960 and culminating in the preservation era.

A few relics survive from the 3ft gauge period: the largest is the body of the locally-built 'Big Saloon' carriage, reconstructed with the aid of an Arts Council PRISM grant (obtained in 2017), from 'kit form', having latterly functioned as a garden shed. There is also a reconstructed four-wheel tipper wagon of 3ft gauge incorporating a superstructure recovered from Fisherground granite quarry.

The Bassett-Lowke 'scale model' locomotives used in the early 15-inch gauge days on the R.&ER are no more, but fortunately two sisters of the first such specimen, Atlantic 'Sans Pareil', survive. The earlier of the two, 'Synolda', (works number 30 of 1912) has been part of the museum's collection since restoration by British Nuclear Fuels apprentices following recovery in a derelict state from Belle Vue Zoo, Manchester in 1978.

This locomotive was originally

PHOTO 3:

Two carriages were provided for 3ft gauge passenger traffic. Much of the body of the locally-built 'Big Saloon' survived as a garden shed and was rescued by the museum.

PHOTO 4:

The body of this reconstructed 3ft gauge tipping wagon was recovered from Fisherground granite quarry.

PHOTO 5:

Also extensively restored is this four-wheel Bassett-Lowke carriage, one of a dozen used by Narrow Gauge Railways, original operator of the 15-inch gauge R&ER.

PHOTO 6:

'Stretched' 20-seat 1969 version of Dawson bogie carriage, built by Myers and Bowman.

PHOTO 7:

This Heywood four-wheel wagon with detachable 'top', was built at Duffield Bank Works in 1895.



built for Sir Robert Walker's first estate line at Sand Hutton near York. It is in working order and sometimes works specials on the R&ER system. During the 2017 season, some of these were undertaken in tandem with visiting sister 'Count Louis' (32 of 1924).

Until the arrival of Katie, no complete Heywood locomotive survived on the R&ER (though much

of the chassis of 'Muriel' survives, having been incorporated into 'River Irt' in 1927), but some Heywood components have become part of the museum's collection.

These include the side tanks of 'Ella' and Muriel (currently stored at Murthwaite); Ella's well-worn mainframes (this locomotive's axles and five of its flycranks are currently



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part of diesel locomotive 'Shelagh of Eskdale'), and rolling stock-related items including an 1895-vintage ex-Eaton Railway four-wheel wagon; a wooden-framed carriage bogie; a replacement carriage door and a carriage end rail.

A few other Heywood items are in the collection, such as casting patterns for track components, locomotive flycranks and a firebox backhead.

The 1920s are well represented in

the museum and the interactive display constructed around River Esk's boiler has already been mentioned. The decade saw some interesting experiments on the R&ER in the field of internal combustion motive power and two units in the collection are interesting survivals from this period. 'ICL No.1' was constructed in 1926 using Model-T Ford transmission components recovered from a re-gauged 'Crew

PHOTO 8:

While well-worn, the historic value of the frames from Sir Arthur Heywood's 1881-built loco 'Ella' cannot be underestimated

PHOTO 9:

'ICL No. 1' was built in 1926 utilizing Ford Model-T components and a bogie from an ex-Sand Hutton Railway carriage. It holds the speed record over the length of the line, having once done the trip in 15 minutes.

PHOTO 10:

'Katie' ran short return trips during its rededication on 28th April, the author here on the footplate.

PHOTO 11:

Three Muir-Hill tractors were purchased for stone traffic in the 1920s.

Tractor' whose engine had met an untimely and unfortunate end.

Despite needing a new body following a collision with 'ICL No. 2' (which incorporated Ella's mainframes) in 1927, ICL No. 1 (also known as 'Bunny') remained in use as a locomotive until 1962, after which its engine was removed and it was used as a tool van. It was restored during the 1990s using a suitably acquired Model-T engine and was filmed running under its own power again on 3rd January 1999. Currently not in running condition, the unit has undergone some cosmetic restoration in 2017 immediately prior to entering the museum.

Mineral haulers

In order to handle granite traffic that was very much a feature of the line's operating practice during the inter-war period, World War Two and immediately afterwards, three Muir-Hill-Fordson four-wheeled tractor locomotives were purchased. The oldest of these, dating from 1926 and now known as 'Quarryman', is part of the museum collection and remains in working order, seeing occasional outings. The mainframe of its cannibalised sister is also part of the collection, whilst the third classmate has been extensively rebuilt with a modern diesel engine and runs today as 'Perkins'.

Rolling stock from the 1920s is represented in the collection by two carriages erected at Ravenglass using bodies supplied by Dawson of Barrow. The earlier of the two is a 1922-vintage four-wheeler, originally 'open' and built as a more austere version of the original Bassett-Lowke carriages. It was fitted with a roof in 1961. The other is a 1927-vintage open bogie 'four-compartment 'sixteen seater'. The influence of its design on subsequent R&ER carriage design can still be appreciated today.

Smaller exhibits in the museum range from builder's and name plates to relics from the line's connection

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with the ironstone mining and granite quarrying industries. There is also a large photo archive and an illustration on display even shows one of the original 3 ft gauge Manning Wardle locomotives prior to its being fitted with a side hinged smokebox door.

Despite the relatively short period of time that has elapsed since the museum opened, it has already been recognised by the Heritage Railway Association Awards, named 2017 winner in the Large Groups category.

The rebuilt Katie (which contains the side mainframes of the 1896 original) is in working order and it is envisaged that it will see occasional use, particularly on 'Driver for a Fiver' duties. It was officially 'launched' on 28th April 2018 in the presence of an invited party of those connected with its reconstruction. The day's proceedings included a nameplate unveiling ceremony and a return trip (in open carriages despite the atrocious weather!) from Ravenglass to Dalegarth during the afternoon.

Legacy of the fire

The consequences of the 2013 fire were far-reaching and the destruction of the old workshop building and its lathes, milling machines and drills resulted initially in work having to be taken off-site. Space and machine tools had to be rented from Numech Engineering Ltd at Workington until the new workshop was ready.

Damage to equipment was made worse by the fact that sea water was used to put out the fire, with all of its attendant corrosive properties. At the time of the fire, River Esk's chassis had been stripped down and new wheels, axles, axleboxes, tyres and crankpins fitted. These items were safe as they were on a flat wagon, which was simply pushed out into the open when the fire started.

The boiler and tender were stored in the carriage shed, and the boiler cladding in the locomotive shed and all were also safe. Unfortunately, the cylinders and refurbished valve gear were in the workshop with some components close to the hottest part of the fire. These were thus written off.

The overhaul of River Esk has therefore been somewhat protracted,

PHOTO 13:

The sectioned 1923-built boiler of 'River Esk' is now an exhibit in the museum.

PHOTO 13:

The 2013 workshop fire badly set back the major overhaul of River Esk, the engine's cylinders and refurbished valve gear components lost. Finally in April 2018 the loco was nearing a return to service.

PHOTO 14:

The import and return to steam of Krauss-built Pacific 'Whillan Beck' has been a major advance of recent times. Ahead of the public launch date of 5th May 2018, the loco worked several passenger trains, seen here at Ravenglass with driver Anna Tilsley.

but by April 2018 the work was almost complete in the new workshop, with the replacement cylinders and valve gear very much in evidence. River Esk returned to traffic in July 2018.

Largely owing to the demands of normal routine maintenance, the need for an additional steam locomotive for day-to-day passenger duties on the R&ER has been sorely felt in recent years and thought was even given at one stage to constructing a new unit. Eventually, word got around about 'some engine in a shed in Spain that had not turned a wheel in 80 years'.

The locomotive in question was a 15-inch gauge 4-6-2 'Pacific' built by Krauss of Munich (W/N 8457 of 1929) as Pinta for the Ibero-U.S. Exposition of 1929. After a three-year period of occasional use, this engine was stored for a further three decades until purchased for a projected railway in Madrid. After changing hands again, this time in connection with an abortive scheme in Barcelona, the loco remained in store until 2015.

Following inspection by R&ER staff, who viewed its potential favourably, the Society's Council convened an EGM to propose to the membership the loco's acquisition, repatriation and restoration. The proposal received 95 per cent approval

and a 'Train from Spain' appeal was launched to fund the project.

The Krauss arrived at Ravenglass in February 2016 and much of its first year on British soil was taken up with various tests, such as for compatibility with the R&ER loading gauge. It first moved under its own steam at Ravenglass in late 2016, but it needed a new tender, air braking system and regulator, together with alterations to its wheel profile, before entering regular service on a very snowy 17th March 2018.

Painted in a crimson livery at the time of its acquisition, a ballot of the members decided that a Caledonian Railway-inspired blue livery should be carried by the locomotive at Ravenglass, along with the name 'Whillan Beck', after a watercourse situated close to Dalegarth Station.

Several sister engines to Whillan Beck operate on miniature railways in continental Europe. Representatives from some of these railways were present during at the official naming ceremony, which took place on 5th May 2018. The unveiling of the nameplate was performed by retired R&ER general manager Trevor Stockton, whilst chairman Peter Hensman thanked the members for their efforts in fundraising. **EIM**



Dougal - a 5-inch Barclay

Young Sussex engineer Andrew focuses on machining the steam chest of his entry-level locomotive project.

BY ANDREW STRONGITHARM – Part Six of a series

The steam chest casting is a gunmetal rectangle roughly $\frac{7}{8}$ in thick with two valve rod guides cast on one of the long edges. These guides also partially double up as the valve rod packing glands by threading the first part to take the gland nuts.

There is also a steam chest cover casting which is bolted to the main steam chest by the same bolts which hold this to the port and saddle block. Having a removable cover is useful when setting the valve timing as it provides easy access to the steam chest and port face.

All faces of the main steam chest were initially machined on the Bridgeport mill to the dimensions shown on the drawings. This includes all the internal and external faces, as well as three of the four side faces. The fourth side was also machined square, however it contains the valve rod guides and so care had to be taken to machine around them.

Next, I drilled one of the holes for the valve rods 4.6mm and reamed it to $\frac{3}{16}$ in through the valve rod guide. It is important for these to be drilled at exactly the right height into the steam chest as this determines the height at which the valves are above the ports.

Prior to moving the bed of the mill across to drill the other valve rod hole, I bored an 8.5mm x $\frac{3}{8}$ in deep counter bore into the end of the valve rod guide. I then part threaded this counter bore $\frac{3}{8}$ in x 32tpi with the tap held in the mill's drill chuck, whilst

The prototype 'Dougal' loco is a 2ft 6in gauge Barclay 0-4-0 built in 1946 for the Provan Gasworks in Glasgow and today resident on the Welshpool & Llanfair Light Railway in mid Wales.



the mill was still set up for drilling the original hole to ensure that it was threaded straight.

This counter bore is designed to accept the valve rod stuffing gland, however I decided to adapt the design to accommodate an O-ring to seal the valve rod. I therefore made the threads on the valve rod glands $\frac{5}{16}$ in deep instead of $\frac{3}{8}$ in which left $\frac{1}{16}$ in at the bottom of the counter bore to insert a 1.8mm section silicone O-ring. As the valve rod gland is tightened up, the O-ring is compressed against the valve rod, thus preventing steam leaking from the steam chest.

Several holes

Next, I needed to drill the 14 clearance size 4mm holes around the outside edge of the steam chest which would bolt it down to the corresponding holes on the bottom of the port and saddle block. Starting at a datum point in one corner of the steam chest casting, I used the DRO (Digital Read Out) of the mill to centre drill each of the 14 holes first to confirm the position of each one. I then checked them all using a dial caliper before drilling them out in turn with a 4mm drill. One final pass was used to counter bore each of the 14 holes to a diameter of $\frac{1}{4}$ in and a depth of $\frac{1}{16}$ in.

The steam chest is effectively sandwiched between the port and saddle block and the steam chest cover and therefore I needed a way of sealing steam from escaping through these joints. The solution came in the form of 1.78mm section silicone O-ring cord, which would be gently pushed into a slot between each of the aforementioned counter bores. This was achieved by using a $\frac{1}{16}$ in slot

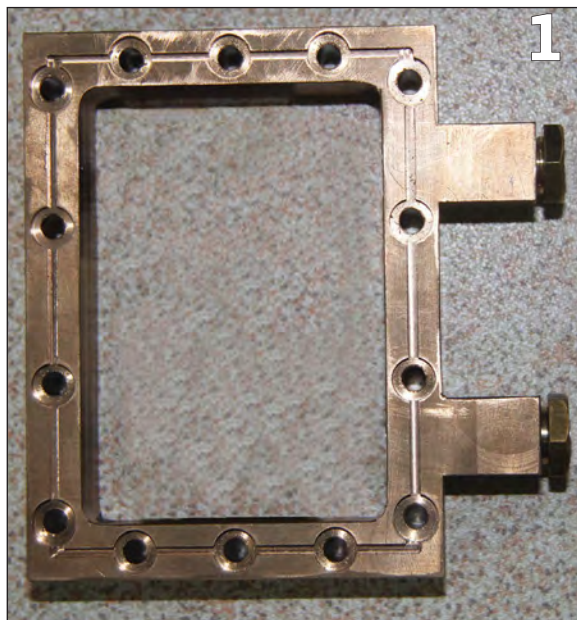
drill to carefully machine a $\frac{1}{16}$ in wide by $\frac{1}{16}$ in deep slot between each counter bore. This was a slow task as I only took 5 thou cuts with each pass of the slot drill.

The depth of these counter bores and slots was determined by the thickness of the O-ring cord, as it was necessary for this to protrude by a good 5 thou to allow sufficient compression when the entire assembly was bolted together.

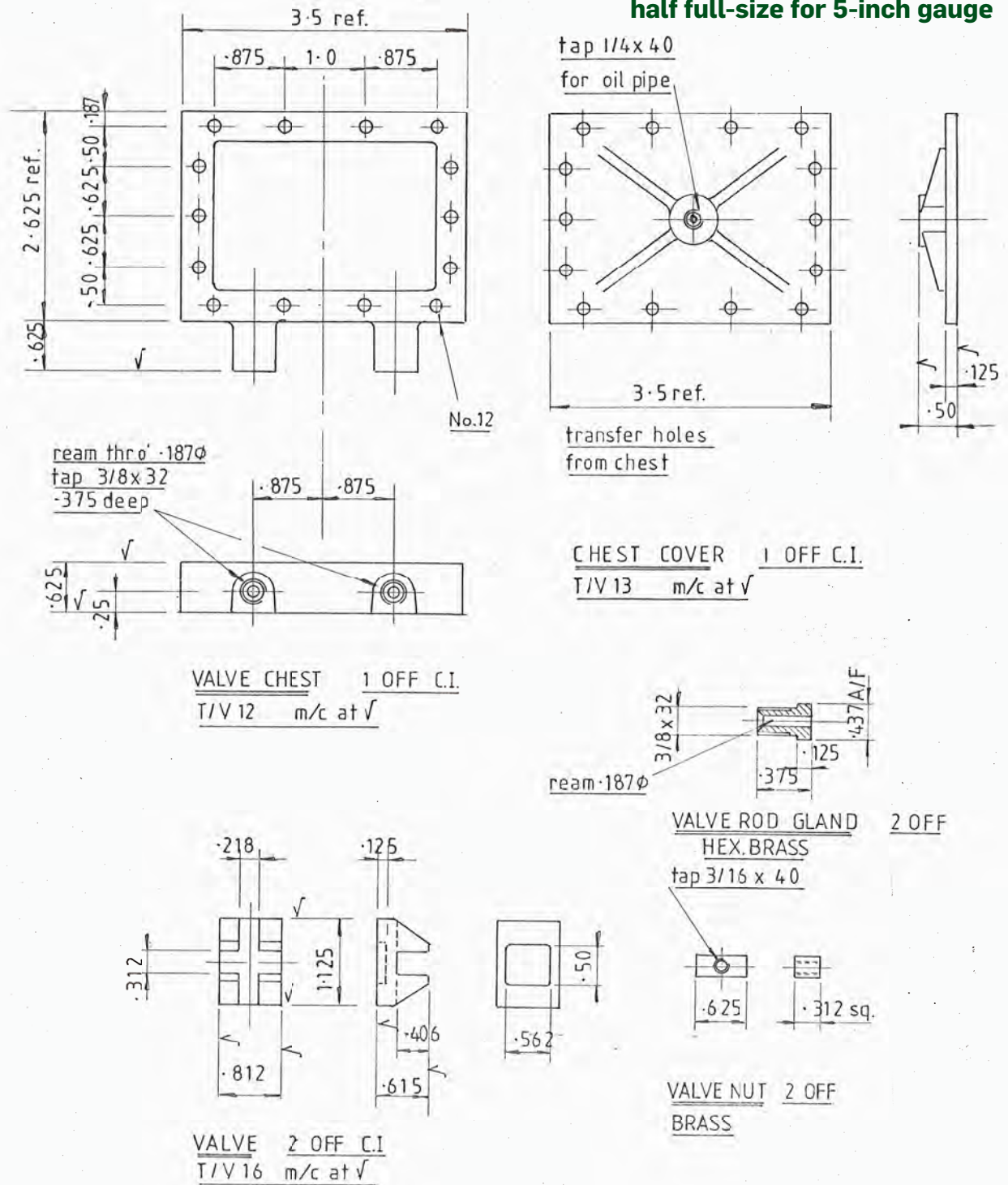
I now had to remove the steam chest from the mill vice, turn it over and repeat the counter boring and slotting process on the other side. This was slightly more complicated because I had to reset my datum point. When machining the first side I was careful to ensure that the outside of the steam chest casting was exactly in line with the side of the mill vice. This meant that as long as all of the holes are symmetrical I could simply turn the casting over on its long edge and by aligning the edge of the steam chest casting with the edge of the mill vice my DRO settings could be retained. To confirm the centre of each hole prior to counter boring, I used a 4mm drill blank held in the drill chuck to double check the centre of each hole again (Photo 1).

Again using the Bridgeport mill, the steam chest cover was relatively simple to machine as the four sides just needed squaring off and the inside face given a quick skim to remove the rough cast finish. On the outside there is webbing cast into the cover to support a central raised boss where the lubricator feeds into the steam chest.

The top of the boss was machined flat and an $\frac{1}{8}$ in hole drilled right



"Having a removable cover is useful when setting the valve timing as it provides easy access to the steam chest and port face..."



ABOVE LEFT:

The finished Dougal loco – this month's build focuses on some unseen components.

PHOTO 1:

The steam chest following the boring and slotting process.

All photos in this feature by Andrew Strongitharm

through the cover for the oil way. The top 1/4in of this hole was then counter bored with a 7/32in slot drill and threaded 1/4in x 40tpi for a fitting for the oil pipe to screw on to. I then machined a 3/8in wide band around the periphery of the outside face of the steam chest cover to give the bolts which would hold it and the steam chest to the port and saddle block a flat surface to tighten up against.

Next, I had to drill the holes to the same spacing as those drilled previously in the steam chest and port and saddle block. These were again drilled out 4mm using the same datum technique as described

previously. Once this was complete I inserted the 4mm bolts to check that all the holes lined up correctly.

I used 4mm cap head bolts to initially hold the steam chest assembly onto the port and saddle block, as I knew that I would need to take the steam chest cover on and off many times whilst setting the locomotive valve timing. This was why I chose to use the O-ring cord as it made the removal of the steam chest cover quick and easy, whilst also providing a seal. The other option would have been to use Loctite 574 flange sealant, but this takes time to set and the faces it is applied to have

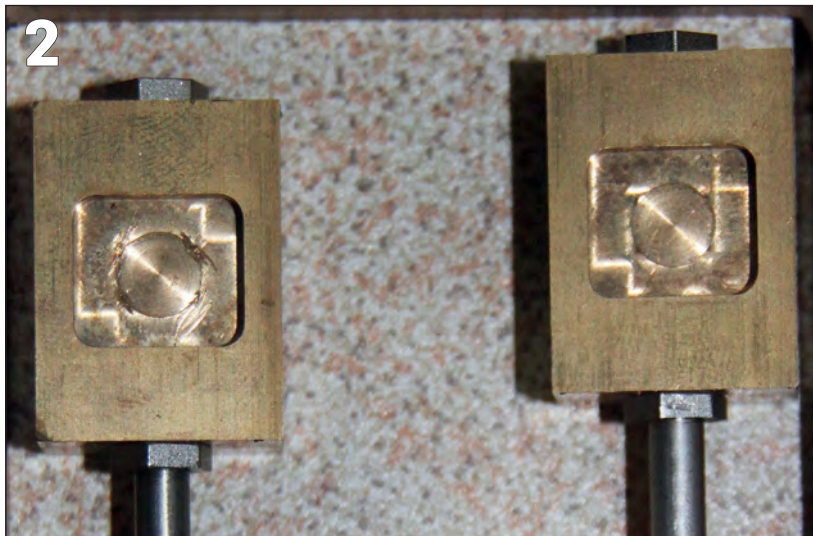
to be thoroughly cleaned every time prior to reapplication.

Fiddly but clean

I will admit that the O-ring cord was very fiddly, however the number of times I had to take the cover on and off more than made up for the time I saved not having to clean off flange sealant. The downside of using the O-ring cord was that it had a tendency to jump out of its slot and regularly required pushing back in to it.

It was also difficult to remove the cover without dislodging the O-ring cord, as once the bolts were removed the cover and steam chest itself were

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loose on the port and saddle block. I attempted to rectify this by making a batch of stainless 4mm studs that would be permanently fitted into the port and saddle block and which contained a plain section of shaft through the steam chest.

A problem with this method emerged after taking the steam chest cover on and off a few times, the difficulty in aligning all 14 studs through the steam chest whilst ensuring that the O-ring cord was not dislodged in the process. I therefore took the studs out and replaced them with a batch of homemade stainless hexagon-head bolts.

A fellow club member donated the material for the two valves. Nothing strange in that I hear you say, however the gunmetal was in the form of a wash-out plug from a full-size British Railways standard locomotive! This did the job perfectly following lengthy machining down to the correct $\frac{13}{16}$ in x 0.615in dimensions. The reason for

the height of the valves being 10 thou under $\frac{7}{8}$ in is because $\frac{7}{8}$ in is the finished height of the steam chest and therefore the valves need to be slightly under this to allow room for them to slide back and forth. It is worth noting that should your steam chest casting be less than $\frac{7}{8}$ in thick do ensure the valves are reduced accordingly.

I then machined a recess into the underside of both valves, which consists of a $\frac{9}{16}$ in x $\frac{1}{2}$ in x $\frac{1}{8}$ in deep rectangle. The function of this recess is to allow exhaust steam to pass from one end or other of the cylinder via the exhaust port to the blast pipe and then up the chimney. Whilst the top of the valves are directing the exhaust steam, the front or back edges expose the other inlet port that is filled by steam which surrounds the valves in the steam chest.

I made another deviation from the drawings at this stage as they show the valves with a cross shape machined into the underside and a nut located

"The gunmetal was in the form of a wash-out plug from a full-size British Railways standard locomotive..."

PHOTO 2:

Close-up of the finished valves.

PHOTO 3:

Valves in place with studs and O-ring chord running in its special slot.

PHOTO 4:

Forked valve rod ends for connecting to eccentrics.

PHOTO 5:

Completed valve chest setup – one more build job ticked off the list.

within the cross which is threaded into the end of the valve rod. Instead, I made them with an elongated hole through the middle which allows the valves a small amount of room to move up and down within the valve rods. This means the valves are able to wear into position as they slide over the port face.

After drilling a $\frac{3}{16}$ in hole lengthways through the valves on the Bridgeport mill, I exchanged the drill for a long series $\frac{3}{16}$ in end mill. Then, and in 5 thou increments, I elongated the holes vertically downwards by 15 thou so that as the valve face wears against the port face the valves are able to move around the valve rod.

Next, I cut and roughly faced to length the two valve rods out of $\frac{3}{16}$ in stainless rod. One end of each was then threaded $\frac{3}{16}$ in x 40tpi by a distance of just over 1 $\frac{1}{4}$ in, which is the overall length of the valves. I then made four very slim nuts out of stainless steel hexagon, two of which were threaded $\frac{3}{16}$ in x 40tpi while the other two nuts were threaded 6BA.

The first two nuts were wound down the valve rods and locked up tight against the end of the $\frac{3}{16}$ in x 40tpi threads. I then pushed the valve rods through the valves and measured the distance of valve rod protruding from the front of each valve.

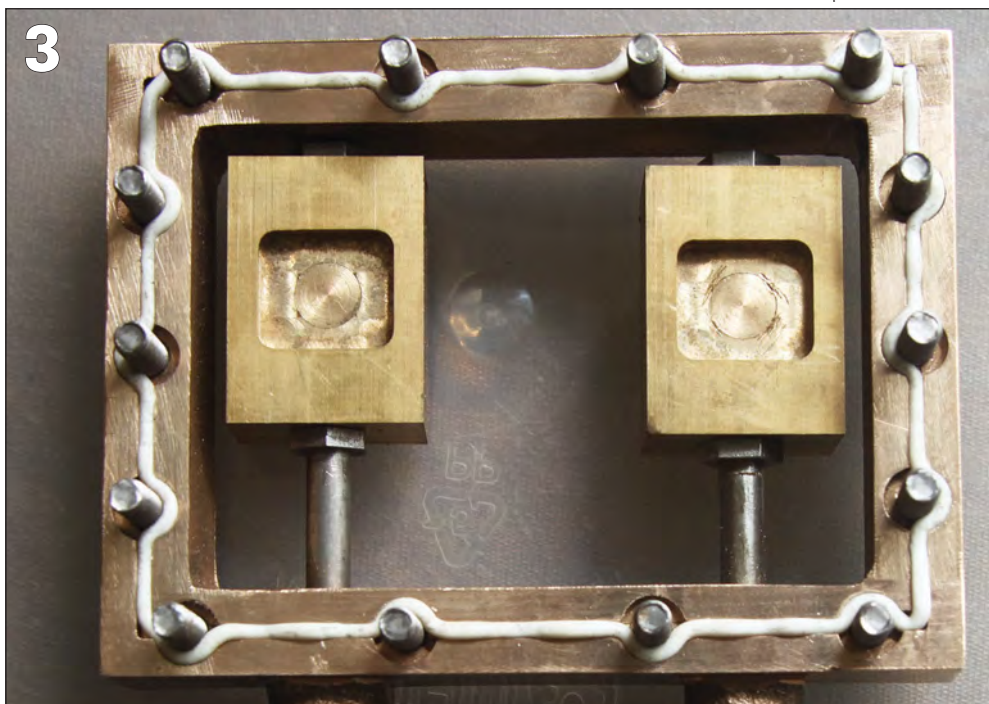
After taking everything apart, I turned the end of each valve rod down by the length that I had just measured, to 0.110in and threaded them 6BA. I put the valve assembly together again, this time screwing the two 6BA nuts onto the end of the valve rods as well, and checked the clearance between both nuts on the end of each valve. The valves need to be free to move on the valve rods (ideally no more than a couple of thou), so it is important that the locking nuts do not do up tight against the valves.

Space challenge

The downside of making the valves in this way is that there is hardly any room to fit the pair of locking nuts either end of each valve. I only just managed to achieve this as the available space inside the steam chest once the valve travel had been taken into consideration was extremely limited. For added piece of mind when I finally assembled the steam chest and valves, which I will describe later in the build, the locking nuts were secured in place using Loctite 271 (Photos 2 & 3).

The steam chest was now essentially finished, so I continued to manufacture the remaining motion components that are situated between the frames, starting with the valve rod fork ends. I began by cutting two pieces of $\frac{3}{8}$ in square mild steel to

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form the valve rod fork ends. These were initially held in a self-centring four-jaw chuck on the Myford lathe and both ends were faced off.

I then turned down one end of each by $\frac{1}{4}$ in to a diameter of $\frac{5}{16}$ in and drilled a $\frac{5}{32}$ in hole the full length of the steel. Next, I threaded these holes $\frac{3}{16}$ in x 40tpi to accept the valve rods, before taking them out of the chuck and setting up the vertical milling attachment on the Myford lathe. I used this to machine the $\frac{1}{8}$ in slot into which the yet to be made eccentric rods would be fitted. After this I used a needle file to remove the burs left by the slot drill.

Centre of attention

I now had to carefully drill the cross holes into the fork ends for the valve gear pins that hold the eccentric rods in position. This hole was supposed to be drilled and reamed $\frac{3}{16}$ in, however I didn't get the hole quite central and therefore I had to file it over and drill it out slightly bigger. Luckily I was able to borrow a 5.2mm machine reamer and this solved the problem.

Next I made a pair of mild steel locking nuts to secure the fork ends in position on the valve rods. These were $\frac{3}{16}$ in thick and I chamfered the front edge of each nut with a 30 degree taper. The finished locking nuts were screwed onto the valve rods first, followed by the fork ends themselves. The exact number of turns they were screwed on would be determined once the motion was complete and when I began the process of setting the valve timing. This was why I used a 40tpi thread as this gave me fine adjustment on the valve positioning.

The final task on the fork ends was to turn a couple of shouldered silver steel pins and 4BA stainless steel nuts to hold the eccentric rods in place. The pins themselves were machined from $\frac{3}{8}$ in diameter rod turned down to an accurate 5.2mm over a length of 0.380in to suit the fork ends and latterly the eccentric rod bushes too. A further length of $\frac{5}{32}$ in was turned down to 0.140in to be threaded 4BA.

The reason for making the overall length of the main body of the pins 5 thou over $\frac{3}{8}$ in is to ensure the nuts do not clamp the pins across the fork ends. Proper shouldered bolts should allow for a few thou of side play, particularly when used across a fork end to prevent the fork from becoming compressed.

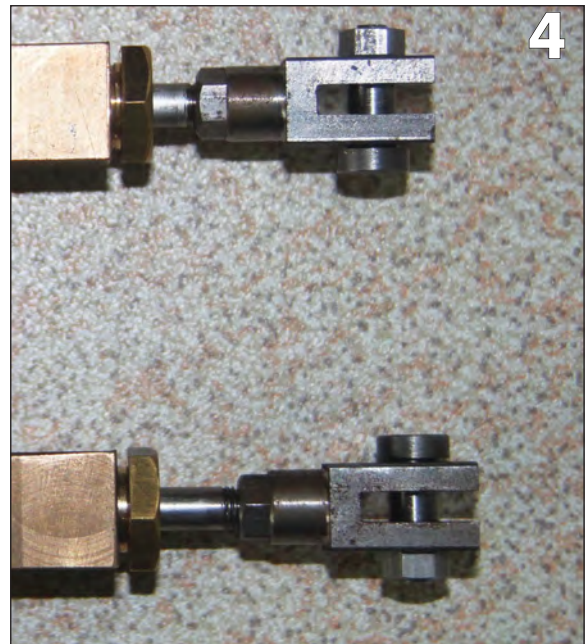
In addition, I also undercut the end of the 4BA thread nearest to the shoulder using a slim 30 thou wide High Speed Steel (HSS) parting tool. The parting tool needs to be inserted by the full depth of the thread plus about 5 thou more. Once this has been achieved, it is good practice to run the

die back up the threads again and then repeat the undercut process one final time. The undercut will allow the stainless steel nut to lock hard up against the shoulder of the pin. Bear in mind that the width of the undercut for coarser threads will need to be larger depending on the thread that is being machined.

With the pins now turned, I cut each one off the rod leaving just over a $\frac{1}{8}$ in head, turned them around and then faced the head back to $\frac{1}{8}$ in exactly. One final task was to machine two spanner flats on each head so they can be tightened up. To achieve this, I made a jig which consisted a piece of $\frac{3}{4}$ in mild steel square with a 5.2mm hole drilled vertically down through it and about $\frac{1}{2}$ in inward from the end. The overall length of the $\frac{3}{4}$ in bar is not critical but for the purposes of this exercise needs to be a good 3 or 4 inches long as a minimum.

Using a 12in hack saw, I then cut a slot centrally from the end of the bar and parallel to the already drilled hole. Once the hack saw had broken through into the hole, I then continued to cut by a further $\frac{1}{2}$ in beyond the hole and I now had the beginnings of a basic clamp. I re-drilled the hole to remove any hack saw burs and mounted the jig in the vice on the vertical slide.

Next, I inserted one of the pins into the jig leaving the head proud by about 30 thou and tightened the vice. The clamp compressed well and firmly held the pin in place. Using a $\frac{1}{4}$ in end mill, I then machined the top and bottom of the head by a $\frac{1}{16}$ in to leave an overall width of $\frac{1}{4}$ in across flats (AF). I repeated this process for the second pin and with this these were now complete. The fork part of the fork ends are supposed to be rounded off, however I must admit that I have never finished mine off (Photos 4 & 5). **EIM**



Drawings in this series reproduced with kind permission of A J Reeves. Drawings, castings and material for this build project are available from A J Reeves.



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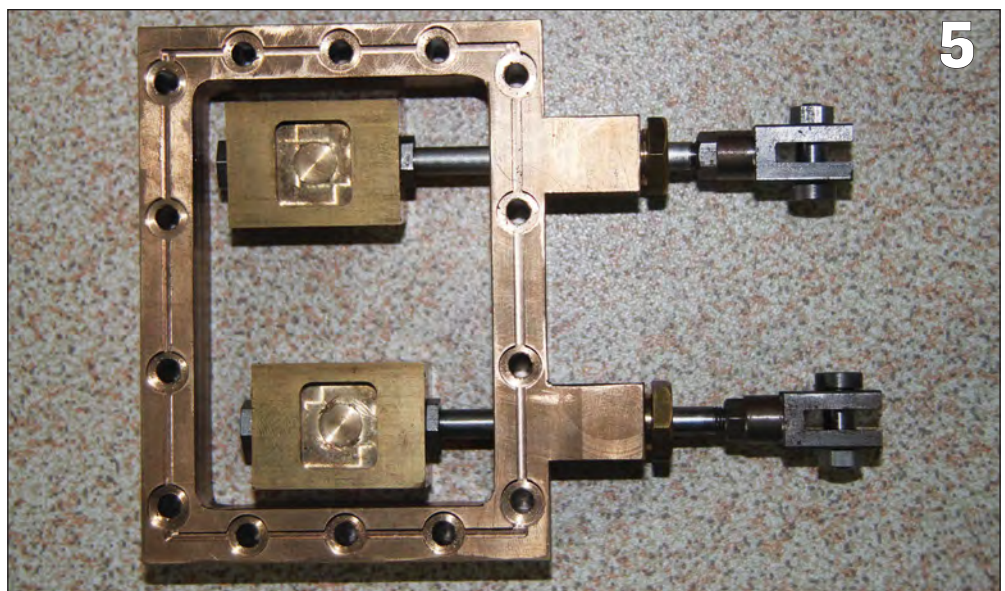
Previous Episodes of the build...

Introducing Dougal, April 2018; Building the boiler, May 2018; Frames, axleboxes, June 2018; Wheels, eccentrics, July 2018; Rods, boiler saddle, August 2018

Digital copies of previous issues can be downloaded or printed versions ordered from www.world-of-railways.co.uk/engineering-in-miniature/store/back-issues/ or by telephoning 01778 392484.

Next Month...

"The first use of soft solder on the project was an interesting comparison to the silver solder I had used building the boiler..." Andrew connects his eccentrics.



Restoring a Sevo 2 machine vice

For Brian the desire to own an unusual vice meant restoring one from derelict condition...

BY BRIAN WOOD

An opportunity for me to buy one of these rather unusual vices, which make gripping odd-shaped work an easy procedure, came recently. I had only earlier that week seen one during an invited tour of a local workshop and was impressed by both the quality and design, thinking at the time how useful one would be in my own workshop.

The one on offer was filthy, neglected and somewhat rusty, but the photograph advertising it showed it was undamaged and was clear enough to confirm the vice had all the potential of being worth the effort at bringing it back into use again.

Having done some work for the seller in the past I was offered it at a favourable rate which made it even more attractive

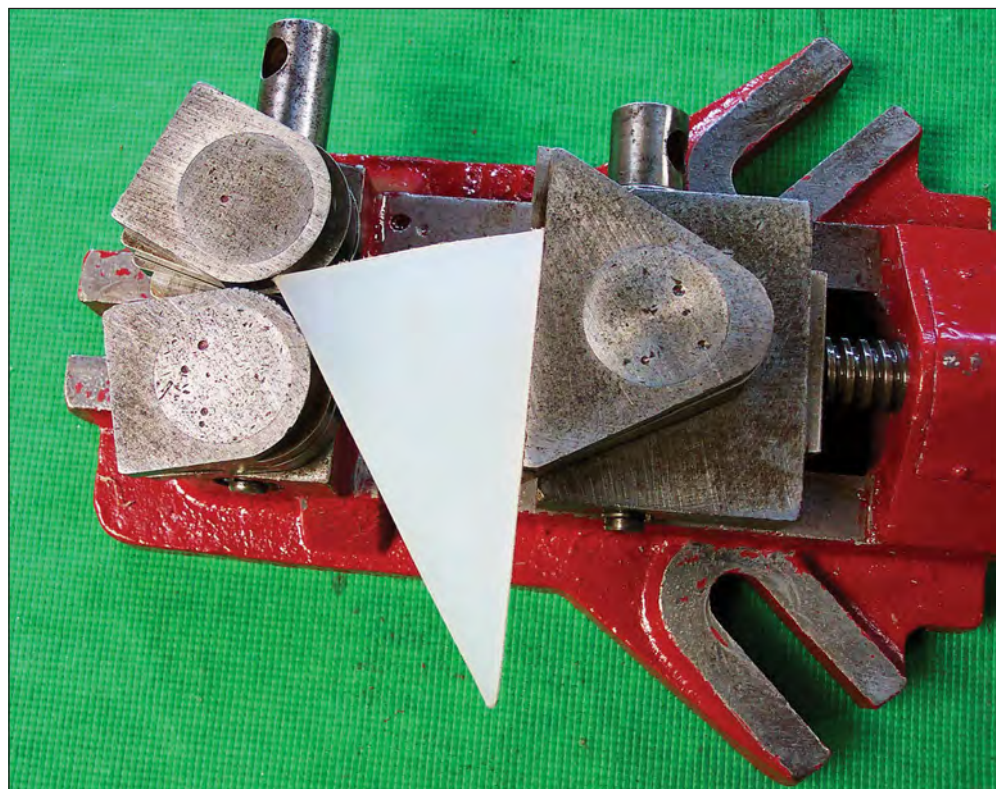
Design philosophy

These vices were made in Sweden but that is about as far as it seems possible to trace their origins. Internet searches failed to list the maker or add much more information other than the UK agents are Spencer Franklin Ltd, who seem to be based in the USA.

Up to the level of the jaws, these vices are of completely traditional design. The jaws are however quite different to the rigid hard blocks that are so familiar. They are made up of self-aligning hardened steel plates, carried on substantial section hardened posts. These are pulled down onto the flat surfaces of the lower sections of the vice body by the action of pins running through them with eccentric cams engaged in holes in the posts. The three lower plates of the set of four in each position have oval holes to allow float on the posts, while the top plate is a close fit onto the flat top of the post which when pulled down by the eccentric clamps the short stack of plates below it.

There are two such posts on the non-moving jaw and one with triangular plates on the moving jaw. These features make it possible to grip odd shapes securely that would be difficult in other designs.

The vices were made in two sizes; this one opens to a little over 50mm capacity, the Sevo 1 to nearer 125mm capacity. The larger version has two



ABOVE: The restored Sevo vice showing its party trick on a dummy triangular work piece

PHOTO 1: Top view of the vice on receipt.

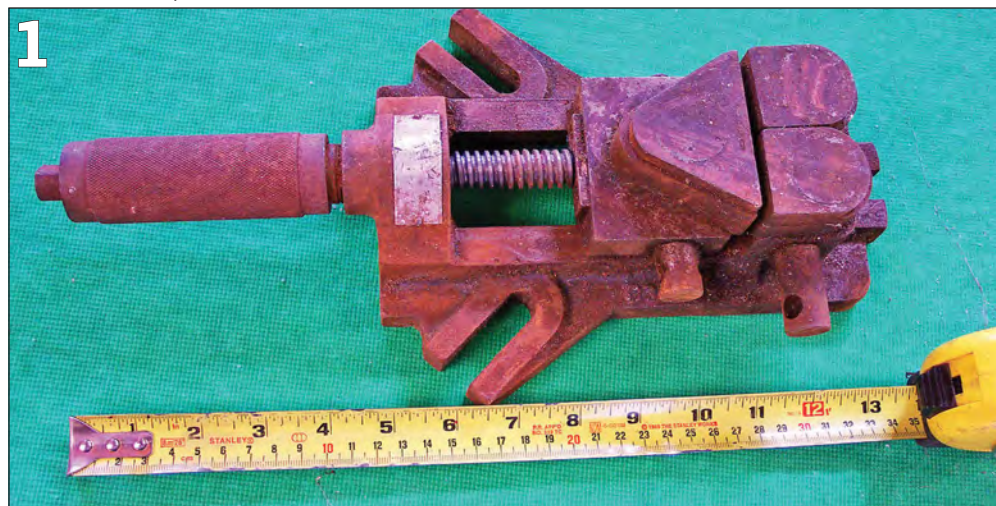
sets of opposed mounting feet on the extremes of the body, in this smaller model the mountings are in a Y formation with the single mounting point at the non-moving jaw end.

The operating screw thread is left hand, 16mm diameter with a pitch of 4mm and being metric it will be of 30 degree trapezoidal form. The Imperial equivalent would be an ACME thread of 29 degree included angle

Restoration work

Photo 1 shows what the vice looked like on arrival from the seller in Dorset. The underside view is shown in **Photo 2** and **Photo 3** is the view from the operating handle end.

On receipt, I filled a plastic box with kerosene and then submerged the vice in it for the night to help soften the dried lubricants and free off the moving parts – these had



become quite stiff from lack of use.

The following day I began the work of brushing it down with an old paint brush whose bristles had worn down beyond use as a working brush. An old toothbrush got into the corners and before very long the worst of the muck was cleaned off, enough at least to make it more pleasant to handle.

At this stage I began dismantling the vice into its component parts; the hardest items to shift oddly enough were the two small slotted countersunk-head screws holding the plate to clamp the operating screw into the moving jaw which then allows it to be drawn backwards.

The swelling for the nut part of the operating screw prevented straight access for the screwdriver blade and was badly angled to only give a partial grip in the slots. Tapping the end of the screwdriver with a nylon-faced hammer at the same time as unscrewing gradually released the grip of the screws, after which they came out easily.

The two spring clips on the end of the jaw operating pins were carefully eased out of their grooves with opposed flat-blade screwdrivers and gripped firmly with nail pincers to wriggle them off over the ends of the pins. Such clips can so easily go 'ping' and never be seen again; I had no wish to try and find them if that happened. If they had escaped I would have made replacements by cutting down a suitable spring lengthwise to separate out a pair of coils to use instead.

Cleaning process

With all the working parts freed off and removed, it was then a question of drying them off and laying everything out in the right order. A wire brush was used to fetch off the remaining rust and dirt from the body.

Photo 4 is a view of the whole vice laid out with some of the jaw segments separated to show the method of fitting. The various components were cleaned of light rust with the careful use of a tired pad of Scotchbrite and a similarly tired foam rubber-filled abrasive block to leave the surfaces just lightly stained. I took care to avoid thinning the sections of the jaw parts and moving jaw carrier, these were all hardened parts and they cleaned up very well.

The jaw edges were also carefully lapped on a fine stone to remove burrs where gripping hard surfaces in the past had raised some bruises. Other than vigorous use of the wire brush along the knurling of the operating handle there was little more to do.

After that treatment, the sharp knurling profile was rejuvenated and gave a very good grip in the hand. The end of the screw shaft protrudes from

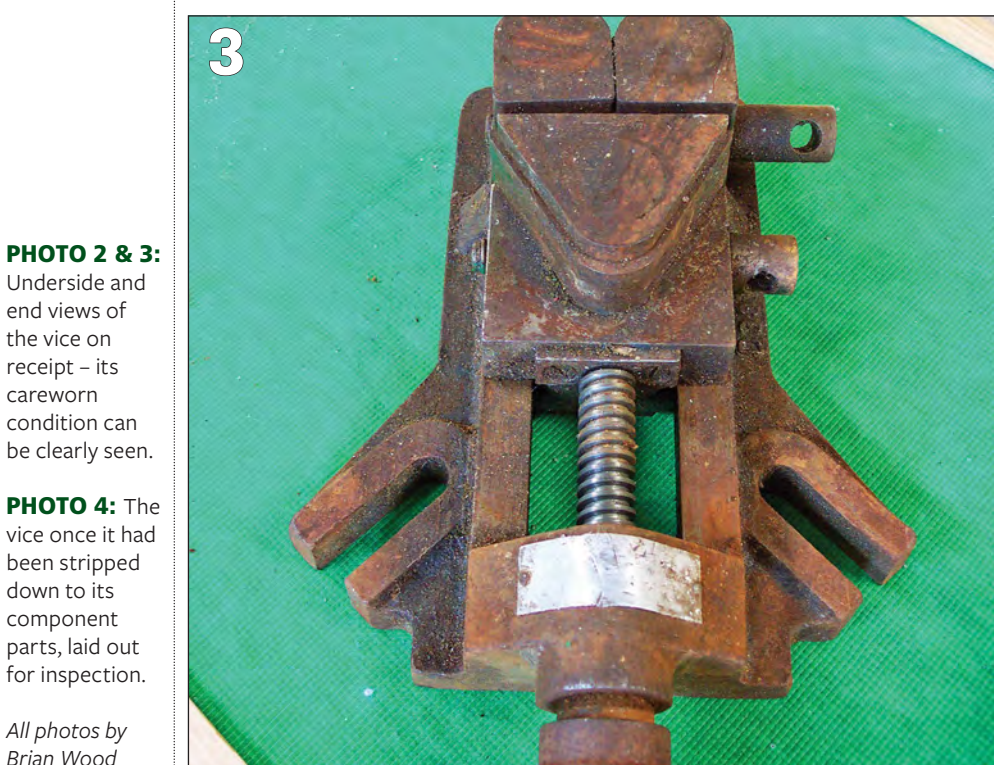
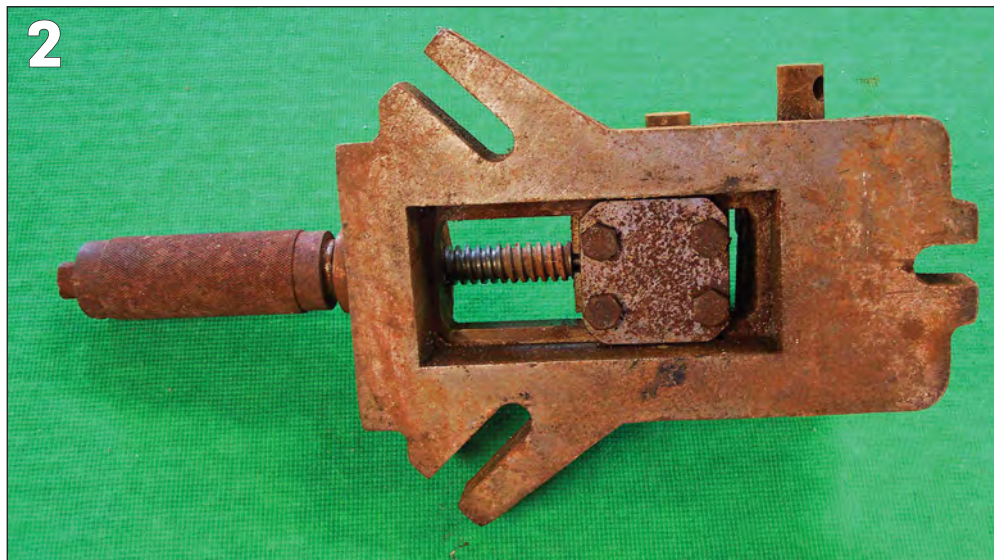
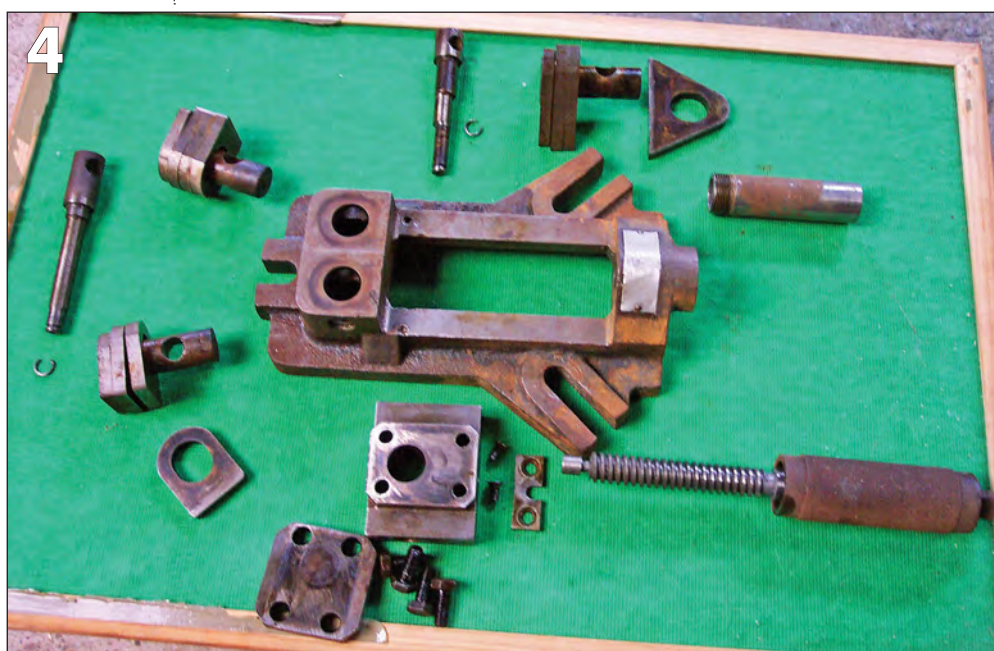


PHOTO 2 & 3:

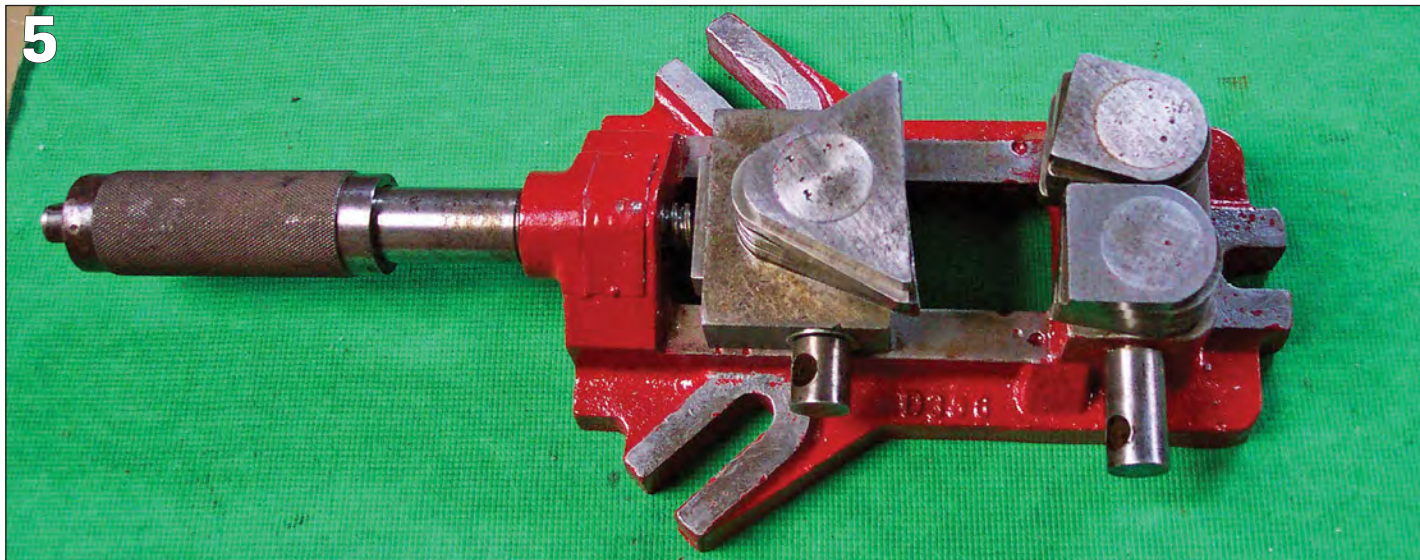
Underside and end views of the vice on receipt – its careworn condition can be clearly seen.

PHOTO 4: The vice once it had been stripped down to its component parts, laid out for inspection.

All photos by Brian Wood



5



the knurled portion to finish in a short milled section with spanner flats in case of need, which is a thoughtful design feature.

The mounting holes for the jaw clamps were carefully cleaned out. Those in the fixed jaw are blind, and the one on the moving jaw had a raised

PHOTO 5:

The finished job, taken from the same viewpoint as Photo1.

PHOTO 6:

Underside view of the finished job, which again can be compared with Photo 2.

PHOTO 7:

Versatility of the vice, here gripping a washer for countersinking.

burr internally caused by a step in the jaw operating pin, Together with float in the pin this had allowed the step to rub on the wall in one place.

A thin washer was made to fit the thick outer section of the pin to limit that movement in future. As the hole for this jaw clamp was bored clear though the burr was carefully removed with an adjustable reamer.

With all the parts cleaned and oiled ready to refit, the next stage was to repaint the body. The raised faces for the holding-down bolts were lightly oiled, similarly the guideways for the moving jaw along with the whole of the flat underside of the vice to prevent the paint getting a grip. The surfaces onto which the jaw segments are clamped were similarly treated. The body was then given two spray coats of grey primer and left to harden overnight.

This was followed by two spray coats of a deep red top finish from a rattle can and that too was left to harden up overnight, after warming the body with a hot-air paint stripper gun. The necessary bare surfaces were easily revealed again with a flat-bladed paint scraper and given a light burnish with the Scotchbrite pad.

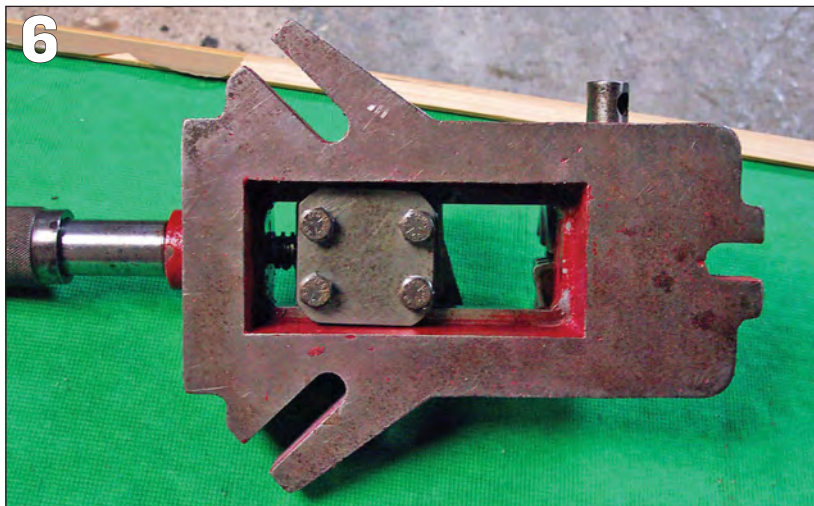
The finished job

Photo 5 and 6 show the finished vice. The operating screw moves with an easy action and the whole accessory is now a pleasure to handle and use.

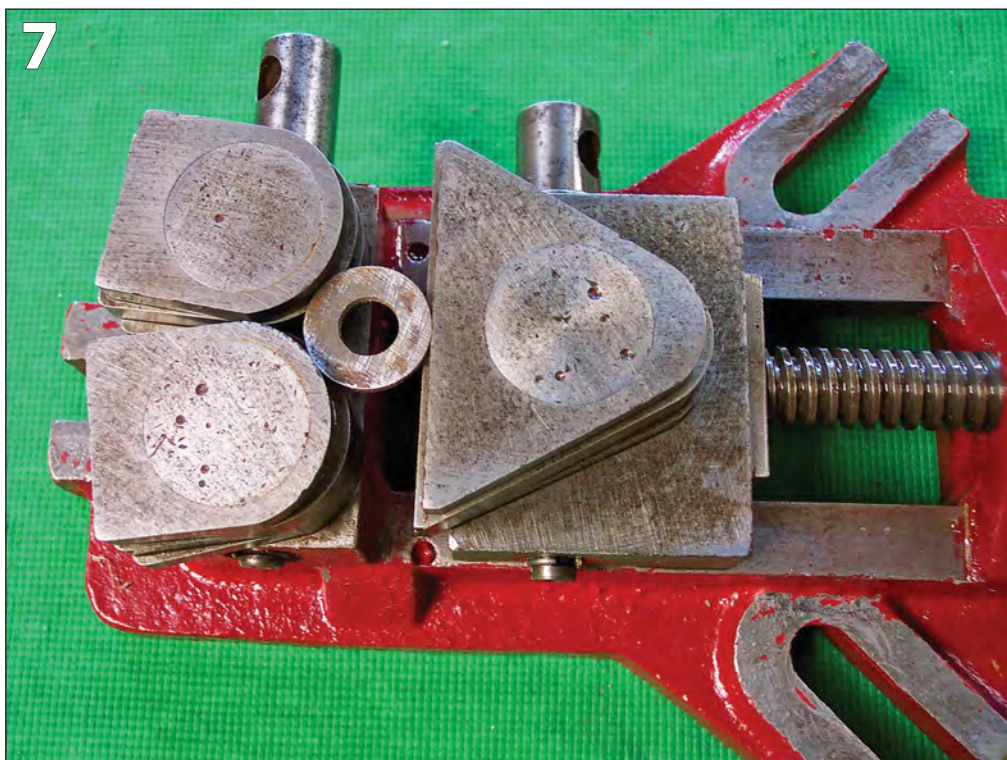
Photo 7 shows the vice holding a typical washer so that the central hole can be countersunk; it is a tedious job on a lathe trying to grip such items in the chuck without a wobble and with enough grip to stop it being forced into the jaws.

The vice is designed to give a washer-like workpiece edge support on three positions, this it does very well. The heading photo is a staged picture showing the type of piece the vice was designed to hold so effectively. **EIM**

6



7



PHOENIX



PRECISION

We Regret that we will **NOT** be at the Midlands Model Engineering show this year.

However Orders placed online at www.phoenix-paints.co.uk during October will receive up to £5.00 credit towards the cost of shipping.

To receive your credit, enter code EIM2018 in the Promotional code box during checkout.

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Shore Party in Wales

The official opening of a new track celebrated seven years of hard work in Llandudno...

BY ANDREW CHARMAN

There was certainly an air of celebration around when EIM joined members of the North Wales Model Engineering Society in Llandudno on Saturday 21st June.

The official opening of the West Shore Miniature Railway, coinciding with celebrations marking the 70th anniversary of the club, marked the culmination of seven years of hard work by members.

Planning had commenced on the new site in early 2011, after the NWMES had been required to remove its track from a field on the other side of Llandudno due to plans by the adjacent school for expansion.

The new site is adjacent to a beach and in the shadow of Llandudno's famed Great Orme (not far from the Great Orme Tramway), and with a large car park and cafe adjacent. On it the club has been able to construct a raised 3½-inch/5-inch gauge track that loops back on itself to give a total running length of some third of a mile.

The track was actually completed in 2016 and the club has been holding Saturday public running sessions since then, while improving the facilities to the point where the official opening ceremony could be scheduled.

Speaking to EIM at the opening day, NWMES chairman Dennis



ABOVE: Centre of attention, the first official run.

BELOW: 'Miss Alice' Carys Lambe was kept busy opening the track and naming a loco.

Postlethwaite said that he had only accepted election as chairman on the basis of a promise. "I told the members I wanted to be running my big red engine around the track at West Shore within five years," Dennis said. "They managed it in four..."

Dennis was full of praise for the support given to the club by local authorities, both Conwy County Council and the Llandudno Town Council. Both bodies had helped the NWMES find a suitable new site and develop it, and Dennis added that both consider the West Shore Miniature Railway an added attraction for Llandudno and an asset to the area.

This was clearly evident by the

roll-call of local dignitaries at the opening event, which as well as offering rides to the public throughout the day also included displays of model engineering work by members and friends, and a couple of model road engines in steam.

Loco naming

Guests included the local MP Guto Bebb, the vice-chairman of Conwy Council Brian Cossey and the Mayor and Mayoress of Llandudno, David and Amanda Hawkins. Assisted by the Mayor the club's 5-inch gauge Speedy locomotive was officially named 'The Brigadier' by year eight student Carys Lambe, who is currently serving as





'Miss Alice' celebrating Llandudno's connections with the classic *Alice in Wonderland* story by Lewis Carroll (Alice Liddell, the 'real' Alice who inspired the character in the story, holidayed in the resort several times in the late 1800s).

Carys then helped Cllr Cossey cut a ribbon across the track, declaring the line open, before joining a train of dignitaries for the first run hauled by The Brigadeer.

The event represented a milestone for a club that was originally formed as a result of three like-minded enthusiasts meeting in a café in Llandudno. Currently the club boasts a membership in the region of 70 with a range of interests which it hopes to develop at West Shore. The present clubhouse is a temporary structure but future plans include a permanent building, and funds raised from the public running days are being put towards this aim.

Public running continues between noon and 4pm on Saturdays and bank holiday Mondays until the end of October, and those wanting to visit will find the track at Trinity Crescent, Llandudno, LL30 2PQ. For more details go to <https://nwmes.org.uk>



ABOVE LEFT:

You can't have a birthday without a cake....

ABOVE & RIGHT:

This is very much a coastal location.

BELOW & BOTTOM RIGHT:

Plenty of loops to exercise locos on – note the temporary clubhouse.

BELOW LEFT:

The displays included some historic models – more on these in future issues.

BOTTOM:

The inaugural run passes the steaming bays.

Photos: Andrew and Rosemary Charman



Federation heads East

The big Southern rally in Cambridge heads this month's round-up from the clubs...

COMPILED BY ANDREW CHARMAN

We start this month's round-up with news of the popular annual rally of the **Southern Federation**, which this year is to be held at the **Cambridge & District Model Engineering Society's** track on 7th-8th September.

The CADMES's pleasant part-wooded site extends to over two acres. It is easily accessible by road, only a mile or so from junction 12 of the M11 on the western edge of Cambridge city, itself a significant tourist centre with lots to see and do in the area – useful for family members who might not share the model engineering passion...

The ground-level main line circuit caters for 7¼-inch and 5-inch gauges, and extends to one kilometre in length, mainly laid with steel rail on recycled plastic sleepers. A large part of the layout also accommodates 3½-inch gauge. There are two off-loading and steaming areas, both with hydraulic lifting tables and line-up systems, making it easy to unload from estate cars, trailers or vans. Each area has a number of steaming bays, with supplies of 12-volt and 24-volt DC power, and soft rain water available at each for boiler filling. CADMES also caters for smaller gauge fans with an extensive tabletop 32 mm gauge layout.

All types of models

The Federation tells us that a small boating pond will be set up for the rally and all types of model, railway locomotives, rolling stock, traction engines, boats, aeroplanes, stationary engines and others will be welcome at the event. Show models will be exhibited in a marquee and prizes will be awarded in various categories.

Both 7¼-inch and 5-inch gauge riding trolleys will be available. As usual, current boiler certificates will be required for steam models, and all running models will need evidence of public liability insurance. Static models of all types will also be very welcome. Space is allocated for those wishing to camp overnight, or to bring caravans, although power and water facilities are limited on site.

Further information will be in a pack sent to those who register for the rally, which you can do by contacting the rally secretary Colin Bell on colingb50@gmail.com or on 01480 880665, for a registration form.

Sounds a fun event – the editor is

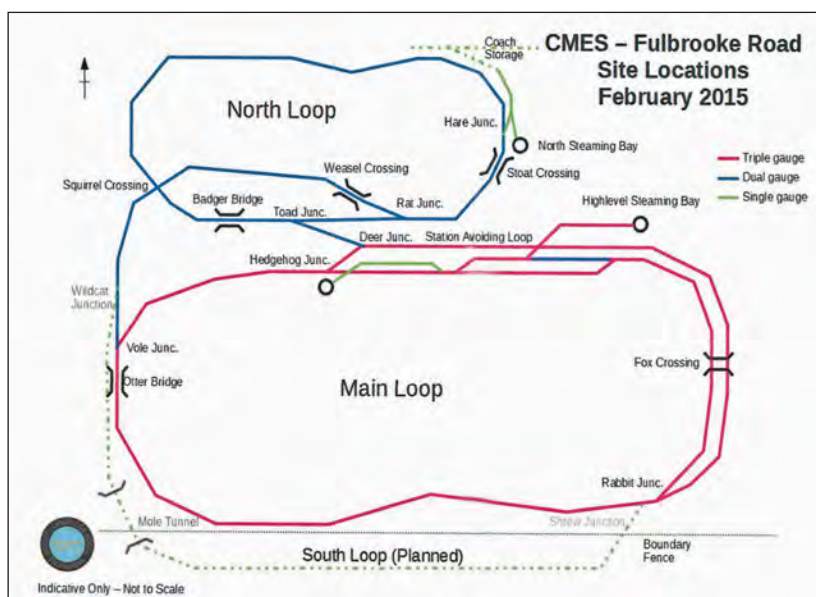
“Des reckons he’s been an inspector almost as long as he’s been a member of the club, and he joined in March 1966...”

ABOVE RIGHT:

The Cambridge track should offer plenty of interest for Southern Federation Rally participants.

BELOW:

Expect busy steaming bays at Cambridge MES during the rally on 7th-8th September.



supposedly not available, due to be working in his other career that day, but he's trying to juggle!

First show

Returning to the definite Welsh theme of this month's club goings-on, some news from the editor's own club, the still very-new **Cambrian Model Engineers**, formed less than a year ago. Fellow member Martin Rant writes; "We were invited to attend the Tregynon Fun Day on 7th July and to exhibit some of our models."

As the day was hot and sunny (at that time most unusual for mid Wales) we chose to have our display in the field behind the community hall. There was a good turnout of members

to help, and a fine mix of models was put on show for the spectators.

Notable items on display included Geoff Bentley's animated club logo, Dewi Williams' collection of farm implements, a fine 2.5-inch gauge 'Purley Grange' under construction by Steve Terris and James Buxton's skeleton clock.

Also on show were several stationary engines, including a fascinating hit-and-miss engine, and a clever skein holder and wool winder.

The day was enjoyed by all, but we felt that it would have been better had the event been better attended. For the club's first venture into showing it was deemed very successful and it just remains to thank the folks of





Tregynon for their hospitality, and for keeping us fed and watered."

The **High Wycombe MEC** produced no less than 11 locomotives for its first public running day on 27th May, probably a record according to the club's David Savage. The numbers were fortunate, both due a possibly record number of niggling mechanical issues during the day, and very many visitors, particularly in the morning. These included a birthday party group of 50 children, and two trains were kept busy running continuously until 5pm, often joined by a third.

Popular events

The latest edition of the **Romney Marsh MES** newsletter reveals a series of successful events at its track on Rolfe Lane in New Romney, Kent – shame you didn't send us in some photos folks!

The annual open day on 19th May saw 14 visiting engines with members from five different clubs, with no suggestion the excellent turn-out had anything to do with avoiding the coverage of a certain Royal Wedding on the same day...

Similarly the annual Small Locomotive Rally on 27th May saw an increased level of interest after several years of decline. Correspondent Bobby Jones reported that it was like the old days of 2½-inch Gauge

ON THIS PAGE:

Martin Rant sent in a selection of photos from the first show outing by the Cambrian Model Engineers. Clockwise from above they include the club's display, an impressive collection of farm implements made by Dewi Williams, the tender of Steve Terris' 'Purley Grange' and a skeleton clock from James Buxton.

Why not send in some pictures from your event?



Association rallies with seven steam and one diesel loco running and a further two steam locos on display. However Bobby added that it would have been nice to see some 3½-inch gauge locos in action. One of the visitors to the event came all the way from Antwerp, Belgium.

Sticking it out

An important if perhaps thankless job in any model engineering society must be that of boiler inspector – with the role comes huge responsibility including if necessary having to tell members their hard work simply doesn't come up to scratch.

Well the latest *Conrod* newsletter from the **Otago MES** in New Zealand reports the resignation of one of their boiler inspectors, Des Burrow, who is also stepping down from inspecting driving licences. Why? Well Des reckons he's been an inspector almost as long as he's been a member of the club, and he joined in March 1966! We think he deserves some form of long-service award at the very least...

It may be still feel like summer as you read this but don't forget that this magazine is titled September, which means that it's just one month to the

Midlands Model Engineering Exhibition, organised by TEE and sponsored by ourselves.

As ever this is the Autumn show to be at, with almost 1000 models on display at the Warwickshire Exhibition Centre over the four days. There will be some 35 clubs displaying their efforts, and of course all the vital suppliers will be present so you can pick up all you need for your project.

Talking of your own projects, there is still time to enter your model for one of the many competition classes at the show – prizes are on offer and you will receive a commemorative plaque just for exhibiting. Full details and an entry form can be found on the website at www.midlandsmodelengineering.co.uk

The vital show dates you need to know are Thursday to Sunday, 18th-21st October. Next month we will be carrying our traditional four-page pull-out show guide.

And as you have your diaries out, the dates of the 2019 London Model Engineering Exhibition at Alexandra Palace have been announced – it will be held on 18th-20th January.

Keep sending those reports in – and how about some photos too? **EIM**



Help needed for a lorry project

Hunting a Foden

Between December 1985 and October 1989 **EIM** carried a series on building a Foden (an STG Timber Tractor in 4-inch scale) by Ray Prime.

I for my sins bought the castings, or a large bulk of them, from Reeves as a Christmas present to me in order to build something different. But I have hit a few snags along the way, some easily overcome as certain imperial items have been superseded by metric, but....

I can't work out how the electric starter is fitted or where to get the front wings from to name but a couple of things.

I have asked Reeves but they have only bought the rights to make and sell the castings and to date have no one building a model. Is Ray still around? Where did the finished wagons end up?

I have made the steering box, chassis, springs and am well on my way with the front axle. But any assistance or advice from others would be very welcome.

Darren Saunders

To be 3 is not new...

Dear all at **EIM**. You provide articles on so much that is interesting in the world of making model steam locomotives that I am not keeping up to date with my reading! But re-reading the May issue I saw something that I must protest about.

On page 36, in the caption for photos 2 and 3 it states; "2½-inch gauge (now known as Gauge 3)."



Locos hauling their drivers on this gauge have been called 2½-inch for more than my lifetime. Locos hauling trains on this gauge, with their owners looking on, are referred to as Gauge 3.

This gauge has two associations that cater for those interested in it. I would not go to a meeting of the Gauge 3 Society with a riding truck under my arm, and I would not like to see locos at a meeting of the National 2½-inch Gauge Association running without a driver!

John Meaford

Andrew C replies: I subscribe to the view that you learn something new every day and I did not know that! John and possibly others may be pleased to hear I have recently commissioned a piece on the history of 2½-inch gauge for a future edition of the magazine, which will no doubt be informative to me!



LEFT: Darren is making solid progress with his Foden tractor, but needs some help from **EIM** readers...

Bisschop by any chance?

I have just found an article in the March 1992 issue of **EIM** by a Cedric C. Mell describing his build of a Bisschop engine.

I fully realise that 26 years have passed, however I am hopeful that there may be records of Mr. Mell, or possibly a club he may have belonged to. I have built a Bisschop to the same stage that Mr Mell's article describes although to half full-size of the engine in the Museum of Science & Industry, Manchester and like Mr Mell I cannot get it to run.

So obviously I am seeking out a possible solution to the problem. His article is the only one I have found that refers to a model of this engine. My model is based on both the MOSI engine and one which is in a private collection here in Victoria Australia. I can be contacted on stewartian8@gmail.com. Thank you.

Ian Stewart

Opinions or information to share? A point to make? **Engineering in Miniature** welcomes letters on all model engineering subjects. Send your letters to the editor at the address on page 3.

PRODUCT NEWS

Silvertown Lubricator detail from 17D

Latest additions to the already extensive range of detailing parts offered by 17D Miniatures are these fine examples of the Silvertown automatic lubricator, reproduced in 7¼-inch scale.

The Silvertown lubricator was designed and developed by the Midland Railway in the early 20th century and later used by locomotives built for the London Midland & Scottish and for British Railways.



The 17D Miniatures detailing parts are available in both eight-feed and 12-feed variants of the lubricator, and each is supplied as a simple kit of four parts in lost wax cast brass, requiring only minimal work to complete and add to one's model.

Both versions are available to order – the eight-feed example costs £86.00 and the £12-feed £92.00, and also available to complement them are both two-feed and three-feed oil boxes.

Already producing a wide selection of detailing parts amongst an extensive range of rolling stock and accessories for both 5-inch and 7¼-inch gauge modellers, 17D tells us that a range of cast and machined parts for BR Standard locomotives are under

development and will be available shortly.

Like the entire 17D range these parts will be wholly manufactured in the UK. More details are on the firm's website.

17d-miniatures.co.uk.

Tel: 01629 825070.

e-mail: sales@17d-miniatures.co.uk

Web: <http://17d-miniatures.co.uk/>

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SEPTEMBER DIARY

EVERY SATURDAY

(Weather permitting)

Burnley & Pendle MRS public rides, Thompson Pk Rly, Burnley, 12-4pm

North Wales MES, public running, West Shore, Llandudno, noon-4pm

South Lakeland MES Public running, Lightburn Park, pm.

Sussex MLS, public running, Beech Hurst, Haywards Heath, 2-5pm

EVERY SUNDAY

(Weather permitting)

Bournemouth SME Public running in Littledown Park 11am – 3.30pm. (Also Wednesdays)

Bradford MES public running, Northcliff Woods, Shipley, 1.30-4pm

Burnley & Pendle MRS public rides, Thompson Pk Rly, Burnley, 12-4pm

Canterbury SME (NZ) Public running from 1pm at Halswell Domain

Chingford ME public running, Ridgeway Park, Chingford E4 6XU, 2-5.30pm

Fylde SME Public running at Thornton Cleveleys from 1pm.

Grimsby & Cleethorpes MES public rides, Waltham Windmill, DN37 0JZ, noon-4pm

Harrow & Wembley SME public rides, Roxbourne Park, Eastcote, 2.30-5pm

Kings Lynn & District SME, Lynnsport Miniature Railway, 11am-4pm

Kinver MES Public running at Kinver 2pm – 4pm.

Lancaster Morecambe ME public running, Cinderbarrow Railway, Tarn Lane, near Yealand Redmayne, from 10am

Portsmouth MES Public running, Bransbury Park, 2pm-5pm

Rochdale SME Public running in Springfield Park from 12 noon.

Ryedale SME public running, Village Hall, Pottergate, north Yorks

Sale Area MES Public running in Walton Park from 12 noon.

Southport MES Public running at Victoria Park 11.30am – 4.30pm

Sussex MLS, public running, Beech Hurst, Haywards Heath, 2-5pm

Urmston MES Public running in Abbotsfield Pk 10am – 4pm

Vale of Aylesbury MES Public running, Quainton Rly Centre, from 12 noon.

Wirral MES Public running, Royden Pk, Frankby, 1-3.30pm.

1 Tiverton MES Steam Up, Worthy Moor from 11am.

2 Frimley Lodge MR Public running 11am– 4pm, Sturt Rd GU16 6HT.

2 Pietermaritzburg MES (NZ), Public running, Pietermaritzburg 3201

2 Plymouth Miniature Steam public running, Pendeen Crescent, Plymouth. PL6 6RE

2 Tyneside SMEE Public Running, Exhibition Park, Newcastle upon Tyne, 11am-3pm

5 Bradford MES meeting Live skills demonstrations, 7.30pm.

7 Portsmouth MES diorama building, Tesco Fratton Centre, 7.30pm

7-8 Southern Federation Rally, Cambridge MES, Fulbrooke Road Cambridge CB3 9EE

8 Bromsgrove SME open day. 16mm, G1, 2½in, 3½in, 5in tracks. peter.maybury@outlook.com

8-9 Sale Area MES Annual Open Weekend, Walton Park from 12 noon.

9 Bracknell RS Public Running, Jocks Lane, RG12 2BH, 2-4.30pm

9 Bristol SME Diesel & Electric Gala, Ashton Court, BS8 3PX

9 Cambridge MES public running, Fulbrooke Rd, Cambridge CB3 9EE, 1.30-5.30pm

9 High Wycombe MEC Bacon Butty Morning, Watchet Ln, Holmer Green, 10am-noon

9 Welling DME public running, next to Falconwood rail station, 2-5pm.

9 High Wycombe MEC meeting, Rossetti Hall, Holmer Green, HP15 6SU, 8pm

14 Tiverton MES meeting, Old Heathcoat School Community Centre, 7.30pm

15 7½in Society AGM and Gathering, Perth

15 Cardiff MES Steam Up and Family Day, Heath Park, 1pm-5pm

16 Bristol SME club day, Ashton Court, BS8 3PX

16 Chichester ME Public Running, Blackberry Lane, PO19 7FS. 1-5pm

16 Plymouth Miniature Steam public running, Pendeen Crescent. PL6 6RE

16 Tiverton MES Steam Up & visit from Brean Steamers, Worthy Moor from 11am.

17 Pietermaritzburg MES (NZ), Meeting, Pietermaritzburg 3201

18 Grimsby & Cleethorpes MES monthly meeting, Waltham Windmill, 7.30pm

18 Model Steam Road Vehicle Society meeting, Fielding & stationary engines by Robert Jackson, Longford Vil Hall, Gloucester, GL2 9EL

23 Bristol SME public running, Ashton Court, BS8 3PX

23 Cardiff MES Open Day, Heath Park, 1pm-5pm

23 Pimlico Light Railway Public Running, Helmdon, Northants, 3-5pm

23 Polly Owners Group Rally, Romney Marsh MES, www.pollyownersgroup.org.uk

23 Welling DME public running, next to Falconwood rail station, 2-5pm.

30 Bristol SME Club Day, Ashton Court, BS8 3PX

Your club's events not listed on this page? Send details to andrewcharman@warnersgroup.co.uk or the postal address on page 3 (at least two months in advance)

Details for inclusion in this diary must be received at the editorial office (see page 3) at least EIGHT weeks prior to publication. Please ensure that full information is given, including the full address of every event being held.

Whilst every possible care is taken in compiling this diary, we cannot accept responsibility for any errors or omissions.

Coming next month in...

THE MAGAZINE FOR MODEL ENGINEERS
ENGINEERING in Miniature

Building a boiler for Martin Gearing's Steam Plant

Milling without tears

Simple locomotive construction

Ways to improve a hacksaw

...and much more!

October issue on sale 20th Sept

Contents correct at time of going to press but subject to change





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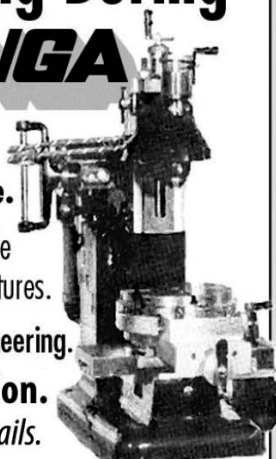
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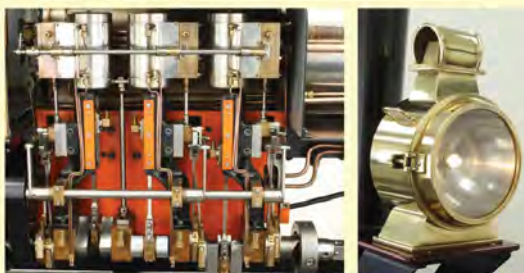
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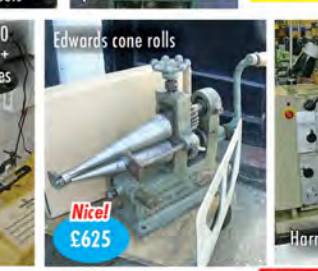
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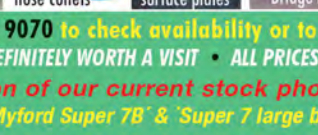
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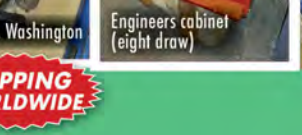
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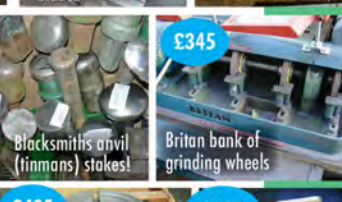
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